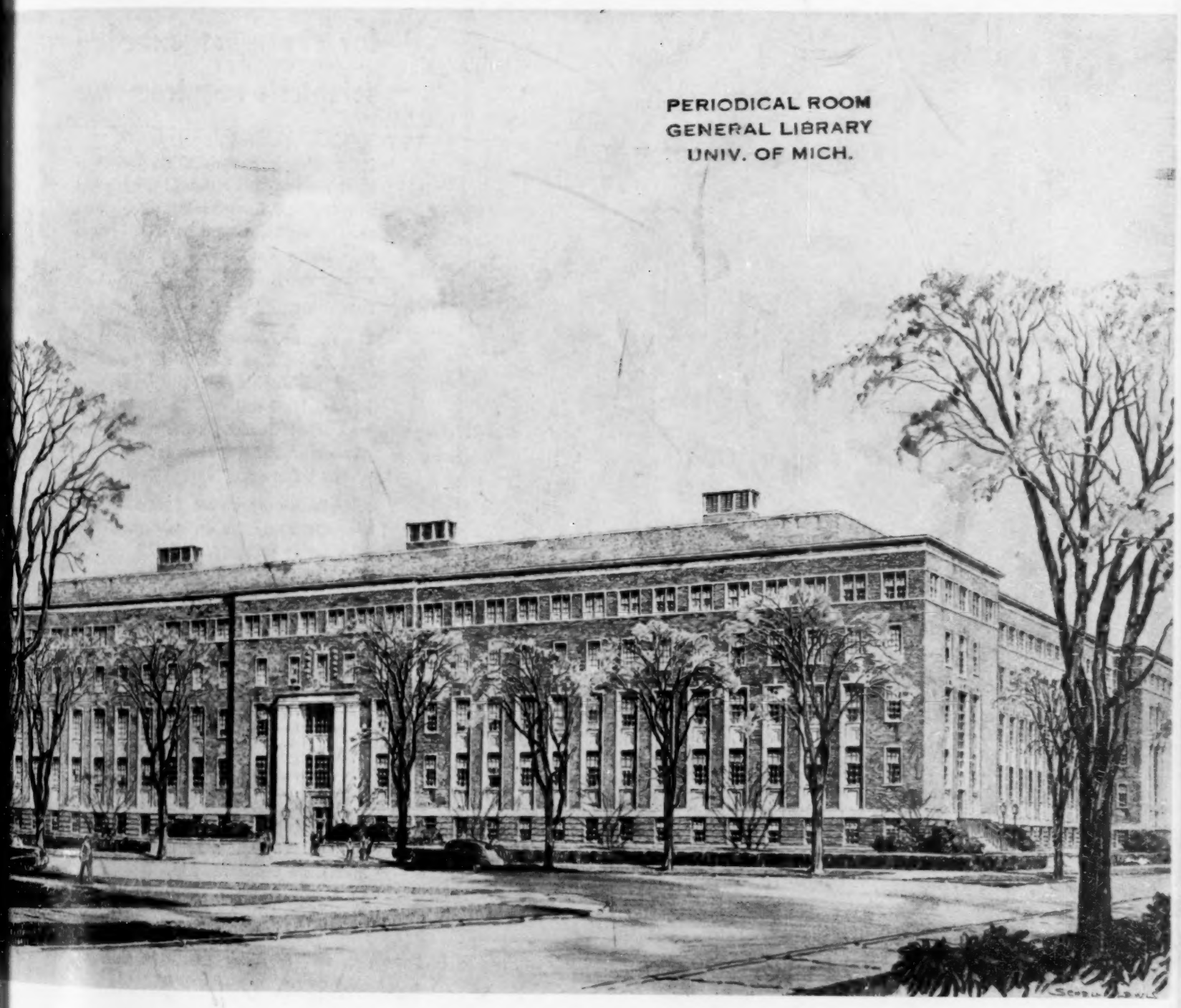
2773 • PAGES 179-206

ruary 20, 1948

Science



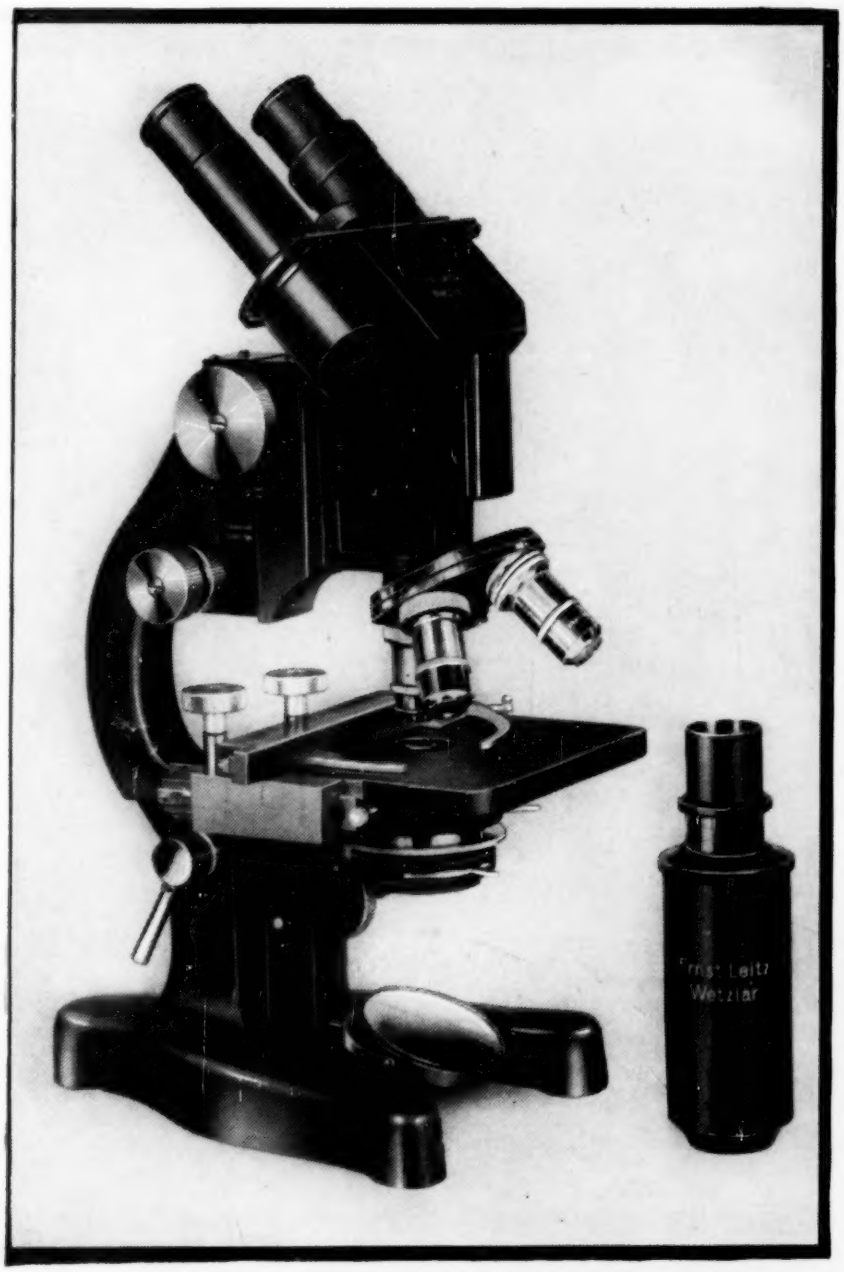
Building

and now...a genuine

..... Leitz

MICROSCOPE

for the most exacting scientific requirements



Inclined Binocular Monocular Model BST 25/92

Leitz Microscopes need no introduction! The Model illustrated is supplied with Inclined Binocular body tube with parallel vision, as well as Interchangeable Monocular body tube for photomicrography.

It has a Quadruple nose piece.

The Coarse Focusing Adjustment is by rack and pinion motion; Fine Adjustment on *double ball bearings* with micrometer head, divided drum and vernier which records the lateral displacement of the Microscope tube within 0.001mm

A built-in Mechanical Stage is provided to cover the entire area of the Microscope slide.

It has a substage with rack and pinion, a Divisible, two-lens Abbe condenser with Iris Diaphragm.

The Optical Outfit meets the standard requirements of the medical profession, consisting of three Achromatic Objectives, including the oil immersion 1/12, as well as one each pair of Huygens Eyepieces 6X and 10X.

It is made by LEITZ, makers of Leica Cameras and other world famous instruments of scientific precision and inimitable craftsmanship.

The present supply is limited but we can still make immediate delivery
Write or wire for quotations

E. LEITZ, Inc., 304 Hudson Street, New York 13, N. Y.

Quoted from The Review in "Science"

"THE research 'is a fact-finding survey in which an attempt is being made to discover what people do sexually and what factors account for differences in sexual behavior among individuals, and among various segments of the population.' It was approached in a commendable and necessary attitude of absolute unconcern with, or lack of any preconception of, what is rare or common, what is normal or abnormal, or what is morally or socially significant. The aim has been to accumulate facts and to attempt to understand the principal factors involved in a motivation of the different behaviors. . . . To suggest but a very small number of the topics among those discussed, one finds data relating to early sexual growth, total sexual outlet, premarital, marital, and extramarital intercourse, masturbation, nocturnal emissions, homosexuality, and the relations of age, social level, religious backgrounds, and other factors to the various facets of the general problem.

The procedures involved in the investigation are carried out by direct questions in a personal interview during which the sexual history is recorded in an essentially unbreakable code form; no written questionnaire has been employed. The strictest confidence has been maintained invariably, and the successful rapport established between interviewer and subject is nothing short of phenomenal. . . . The 12,000 histories already in hand come from every state in the Union, from individuals representing an age range of 5–90 years, and from all social levels — inmates of penal institutions, the underworld in general, laborers, clerks, farmers, business executives, grade schools, high schools, colleges and universities, and such professional levels as lawyers, physicians, clergymen, college professors, psychiatrists, and others. Adequate samples of histories from all social levels and geographical areas are included.

A review of a book frequently carries criticisms of its shortcomings perhaps relative to an ideal. However, one is so thoroughly impressed with the courage demonstrated in the pursuit of this most difficult problem, with the extensiveness of the materials, with the adequate statistical treatments, with the openmindedness with which the entire project has been carried on, with the consummate artistry required to gain the basic information, and with the tenacity exhibited in the collection and presentation of the facts revealing such an unappreciated variation in human behavior, that criticism seems out of place. The entire 804 pages are replete with data. The facts are now available, and in so effectively presenting them the authors are due the gratitude of all intelligent peoples interested in the advancement of knowledge."—*Review by Dr. Carl R. Moore in SCIENCE, December 19, 1947.*

Science

Mildred Atwood, Acting Editor — Theo. J. Christensen, Business Manager

Publications Committee
Roger Adams, John E. Flynn, Kirtley F. Mather, Walter R. Miles, W. J. Robbins, Malcolm H. Soule

Vol. 107 No. 2773 Friday, February 20, 1948

CONTENTS

Science, a weekly journal, is published each Friday by the American Association for the Advancement of Science at James F. McCarthy, Successor to The Science Press Printing Company, Lancaster, Pa. Founded in 1880, it has been since 1900 the official publication of the AAAS. Editorial and Advertising Offices, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Telephone, EXecutive 6060 or 6061. Cable address, SCIMAG, Washington, D. C. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in paragraph 4, Sec. 538, P. L. and R., authorized January 13, 1948.

Articles offered for publication should be sent to the Editor. The AAAS assumes no responsibility for the opinions expressed by contributors. Membership correspondence for the AAAS should be sent to the Administrative Secretary.

Annual subscription, $7.50; single copies, $.25; foreign postage (outside the Pan-American Union), $1.00 extra; Canadian postage, $.50 extra. Remittances and orders for subscriptions and single copies should be sent to the Circulation Department, AAAS, North Queen Street and McGovern Avenue, Lancaster, Pennsylvania, and 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Claims for missing numbers will not be allowed if received more than 60 days from date of issue. No claims allowed from subscribers in Central Europe, Asia, or the Pacific Islands other than Hawaii or because of failure to notify the Circulation Department of a change of address or because copy is missing from the files.

Change of address. Four weeks notice is required for change of address. This should be sent to *Science,* 1515 Massachusetts Avenue, N.W., Washington 5, D. C. When ordering a change, please furnish an address stencil label from a recent issue. Address changes can be made only if the old as well as the new address is supplied.

The American Association for the Advancement of Science also publishes *The Scientific Monthly.* Subscription rates on request.

The Administration of Federal Research

W. V. Lambert
Administrator of Agricultural Research,
U. S. Department of Agriculture, Washington, D. C.

THE REPORT BY THE PRESIDENT'S Scientific Research Board points out that the Government of the United States conducts or finances more than half of the scientific research in the Nation. During the fiscal year 1947, public expenditures for these purposes will exceed $600,000,000. Over 30,000 scientists engaged in such activities are using equipment and facilities worth more than $2,000,000,000. This research covers a tremendous range of activities. In fact, in one way or another it touches on the activities of practically every person in the country and has a profound potential influence on the health, welfare, and safety of the Nation. This scientific program is operated under the direction of 52 more or less independent bureaus located within the major agencies of the Government, and the research is carried on in hundreds of laboratories throughout this and other countries.

My remarks here will be based on my experience in administering research in the U. S. Department of Agriculture. Since agriculture covers such a broad field of activities, many of the problems of directing research in the Department are no doubt the same as those encountered by other government units.

Problems in Research Administration

A research administrator must deal with highly specialized personnel who, by their training and experience, are inclined to be more individualistic in their thinking than most members of society. His job is to help provide facilities, a proper research environment, and an organization that will direct their energies into the most productive channels. In many government agencies these problems differ from those of other research agencies in the wide scope of the activities covered and in the great areas over which the operations must be carried out. As an example, the research of the Department of Agriculture is conducted in over 200 laboratories scattered throughout the Nation and in several foreign countries. It is concerned not only with improvement of all the crops and livestock in the country, but with the protection of these crops and livestock—and human beings too—from insects and diseases, better nutrition of man and animals, all phases of soil investigations, including its conservation, the forests, sound farm production economics, the efficient marketing of agricultural products from the farmer to the consumer's shelf, and finding new uses for the products of the farm.

The administrators of government research are, therefore, always confronted with more problems than they can adequately cover with the staff and facilities at their disposal. The basic problem confronting them is that of organizing a staff and providing facilities that will bring to the solution of these problems the best minds and equipment available, with a minimum of duplication. This must be done within the limitations of the various acts of Congress providing funds for these activities and within the framework of such rules and regulations as have been laid down by the Civil Service Commission, the General Accounting Office, and the various other agencies of the Government.

Scientific Personnel

The recruitment and maintenance of a good scientific staff is a most important feature of research administration. The public, for many years, has insisted that those chosen from among the applicants for government work should be the most competent and should be picked without reference to personal favoritism, political influence, or religious connection. The Civil Service Commission was set up for the purpose of carrying out this mandate and has been functioning efficiently for many years. In fact, the recognition of the special qualifications required for scientific work was one of the influences that stimulated the establishment of the Commission.

Scientists in general appreciate the desirability of competitive selection. Nevertheless, our scientific groups have been among those most critical of the procedure that the Government has so far adopted for the selection and promotion of technical personnel. These criticisms have included the delays involved in making selection among applicants, the difficulty in choosing between those having different types of capabilities, the supposed limited opportunities for advancement, even for brilliant and original research workers, and the lack of freedom in choosing projects to be undertaken.

This address, delivered at a special session on Science in National Affairs held on December 29, 1947, in Chicago, Illinois, during the AAAS meeting, considers one aspect of the President's Scientific Research Board Reports.

One of the difficulties that every government research administrator has to face is the job of replacing key people who are enticed away from government research by flattering offers from industry. I am convinced that we shall have to give greater recognition to our scientists—not only in terms of better salaries, but in other ways, such as sabbatical leave.

We expect a research worker in the Department to have spent as much time preparing for his work as though he were going to begin the practice of medicine. After 7 years of college and university work we offer young men and women compensation considerably lower than they could earn if they were skilled laborers. The more competent of them are eventually advanced to the point where they are making as much as a highly skilled mechanic. Others work up to be project and division leaders, but there is room for only a few in these positions, and those who are chosen are often picked for administrative ability rather than ability to do original research. It is just as well that they are, because there is little opportunity to do research in an administrative job. Too often our system promotes the best research people to jobs that are not research at all. We need to invest part of our research funds in financial and professional advancement that will make it attractive for our best scientists to stay in research.

I am happy to report that there is an increased consciousness in governmental research agencies of the importance of problems of scientific personnel. Research administrators are well aware of the fact that the success of their programs is dependent upon the men who are in the laboratories, and many efforts are being made to improve the lot of the scientist in Government. One of the most important steps in this direction was taken about two years ago when an Interdepartmental Committee on Scientific Personnel was established. This Committee has been effective in bringing about many desirable changes affecting such personnel, and I trust that only a beginning has been made.

Planning and Coordinating Research

The studies made by the President's Research Board indicate that the methods used in the planning, evaluation, and coordination of research are as numerous as the agencies conducting it. In some units of Government little effort is made in this direction above the level of Bureaus. In many, however, a definite attempt is being made to plan and coordinate the research carried on by the different agencies within a Department. Examples of this are the Office of Naval Research, the Research and Development Board for the military agencies, and the Agricultural Research Administration. Each of these units was established to assist in the over-all planning and coordination of research in order to make the most effective and economical use of the research facilities and funds. This step, a relatively recent innovation in Government, was greatly stimulated during the war by the need of teams of research men to get quick answers to urgent problems. Its extension since the war indicates that the method is effective, at least for many types of research, and it seems likely that the use of this technique will be increased.

The Agricultural Research Administration of the Department of Agriculture—the example of this approach with which I am most familiar—was established in 1942 by Executive Order, and most of the large Bureaus doing biological, chemical, physical, and engineering research in the Department were included in it. More recently, the Secretary has placed additional responsibility on this agency by requiring that all except economic research be coordinated through it.

The aim of the Agricultural Research Administration is to use most effectively the forces available to the Department in the solution of the many problems confronting agriculture. Broad control over the activities of the various agencies is obtained by the use of a project system which serves not only for research accounting but for financial accounting of the many research activities. These projects are subdivided into three categories: financial, work, and line projects. The first two define broad categories of work and are used principally for financial accounting and for presenting budgetary requests to the Budget Bureau and the committees of Congress. For example, all the research relating to cereal crops and diseases comprises one financial project. Since this covers a very wide variety of continuing activities on many crops and in all sections of the country, it is broken down further into work projects. Three examples of work projects under this financial project are the investigations on corn, on wheat, and on sorghums.

The line projects represent rather narrow phases of research, usually limited as to both time and subject matter. These are used extensively by the Administration in keeping a record of all research in progress and for getting teamwork between the different units of the Administration.

In this process all planning starts with the men who are doing the research. Line projects are developed within the framework of the financial and work projects, and these are submitted to the Administrator's Office for final approval.

The staff of the Administrator's Office is small. Its function is to assist in the over-all planning and co-

ordination of the program to prevent unnecessary duplication, and to stimulate teamwork where it is needed.

Each project is reviewed by a specialist in the Office of the Administrator in relation to all other activities under way in that particular field. If the project represents an entirely new and independent activity, it is approved for such a term as the project leader estimates will probably be required for its completion, but this period may not exceed 5 years without further review and revision. If, however, the project involves activities that tie in with research being done in other agencies, then the administrative specialist handling this phase of the work calls the leaders of the various projects together to work out a program that will result in as little duplication as possible and one that will extend the efforts of our scientists over a wider range of activities.

In the operation of this program we are very conscious that efficiency cannot be achieved by orders, directives, or commands, but that the understanding and cooperation of the men and women who do the work is an absolute requisite for efficiency and real success. Consequently, we are very alert to protect the rights of the individual worker. Our efforts are continually directed toward developing a wider understanding among the research staff of the purpose and advantages of this method of approach.

In general, this approach is more effective for the developmental or applied phases of research than for research of a fundamental character. Planning the latter type of research is much more difficult, since progress on fundamental research depends so largely upon the opportunity for free enquiry by gifted minds. Even here, however, we think that our project system is reasonably effective. In the line project the researcher is required to specify only the objective of his field of work and the general approach he intends to follow in reaching it.

We are ever conscious that the setting in which scientists live and work profoundly affects their productivity, and that the heart of the problem of scientific administration is the large element of self-direction necessary for scientific and technical personnel. It must be the primary purpose of public policy to provide such an environment if we are to expect the greatest benefit from research programs.

Since the research activities of the Department of Agriculture affect the welfare of so many segments of our population, one additional step in the planning of our programs merits mention. This is the use of advisory committees composed of representatives of farmers, industry, scientists, and consumers. Such committees are brought into Washington or to our field laboratories to confer with our scientific staffs. In this way we obtain the suggestions of farm and industry leaders and the reactions of other scientific men to the proposed programs. Obviously, this technique is most useful in the applied and developmental aspects of our research program. It has the further merit of educating agricultural leaders regarding the importance and nature of our program and thus is a valuable tool in the educational process necessary in translating the results of research into practice.

Coordination of USDA Research With That of State Experiment Stations

In addition to conducting a large research program of its own, the Department carries on extensive cooperation with the State Agricultural Experiment Stations. It also administers the Federal-grant funds allocated to the State stations. These funds are administered through the Research Administration by the Chief of the Office of Experiment Stations, who is also an Assistant Research Administrator. The many projects in progress in these experiment stations are also handled on the basis of line projects which must have the approval of the Office of Experiment Stations before work is begun. This furnishes an excellent means of coordinating the federally supported work in the experiment stations with similar work in other states and that of the research agencies in the Department. This system, which has evolved gradually over several decades, is, I believe, one of the most effective methods of large-scale research coordination on record.

The State stations are independent agencies, usually a part of the land-grant college or university of each state. They derive about one-fourth of their funds from Federal grants and three-fourths from State funds.

Much of our cooperation with the experiment stations and other agencies involves problems that are regional or national in nature, as the swine-breeding program in the Corn Belt states, and the soil-salinity investigations in the western states. Since these projects usually involve a number of agencies, an integrated attack on a particular problem requires most careful planning. This is usually done by having a special leader for the program and a group of collaborators from the various agencies who act as a scientific board of directors for the project. This board usually meets at least once a year to take stock of progress and to make additional or revised plans for the next year's program. After a program is agreed upon, line projects specifying the part that each agency will take are drawn up, to be modified as occasion demands. In addition, we use memoranda of understanding for spelling out the over-all rela-

tions between the cooperating agencies. Many of these projects have been very effective in improving agricultural practices and in increasing agricultural production.

Coordination of Federal Research

The Department of Agriculture has cooperative relations with many other Departments of the Government on research matters. This cooperation is purely voluntary and has not presented any major problems in administration.

No mechanism exists to provide for coordination of research among Federal agencies in the way that I have described for the agencies of the Department of Agriculture. The subjects investigated by the various government agencies are so specialized and so diverse in character that I doubt if the degree of coordination exercised by the Agricultural Research Administration would be feasible. However, in the interests of economy and most efficient use of our research manpower and resources, some coordination at this level seems desirable. To bring this about, the President's Scientific Research Board has recommended that these four steps be taken immediately:

(1) That an Inter-Departmental Committee on Scientific Research and Development be established, to consist of the directors of the major research activities in the various agencies of Government.

(2) That the Bureau of the Budget set up a special unit whose function would be to review the scientific research and development programs of the various governmental agencies and to pass upon all requests for appropriations from these agencies.

(3) That a member of the White House staff be designated by the President for the purpose of scientific liaison between the White House, the various research agencies, Congress, and scientific societies.

(4) That a National Science Foundation be established on sound lines.

Such a program no doubt would result in an effective beginning toward better coordination of research activities of the Government and would perhaps serve as the first step in the evolution of an effective system of coordination that would be sufficiently flexible to meet the requirements of sound research without stifling the initiative of the individual worker. In my judgment, any system that is developed must provide for the maximum protection of the individual worker, and research men as a body must be zealous in resisting any moves that may tend to make them subservient to any large administrative system. In the final analysis, any system that is evolved should assure that freedom of inquiry by gifted individuals which has made science such a powerful tool in the advancement of human welfare.

Budgetary Problems in the Administration of Research

The size and the wide scope of the Federal research program requires a rather complicated budget procedure. Obviously, it is impossible for each researcher to have the opportunity to present his request for funds to the Budget Bureau and to the appropriation committees of Congress. Consequently, budget estimates must be prepared first in the sections or divisions, and then be successively reviewed and consolidated in the bureaus, by the Research Administration (in the case of Agriculture), and finally by the Department budget committee, where final selections with respect to increases or decreases for the various activities are made. The final figures are consolidated into an over-all budget for the Department. This, in turn, is submitted to the Budget Bureau, where the estimates are again reviewed and are finally consolidated into an over-all budget for the Government. This is the budget upon which the committees of Congress must act and which must be defended before these committees by bureau chiefs and agency heads of the Government.

Because of the time required for this process and the need for those who must defend these budgets before the respective committees to have the best possible understanding of all research activities, it is necessary to have the fullest cooperation of research men in getting information about their activities, especially those for which increases in funds are requested. For agencies like the Department of Agriculture, in which the research staff is widely scattered, this is a major task.

Two methods are used for doing this. The first is to require rather complete annual reports on line projects, and the second is by conference with the heads of the respective laboratories or field stations. Both are important in helping administrative officials in developing final budgets, as well as being of great assistance in evaluating progress on research activities. So far as is practical, these procedures are supplemented by visits of administrative people to the field stations and laboratories—a process that has great value not only in informing administrators regarding research activities but in giving the workers in the laboratories a better understanding of the problems confronting administrators and their staffs.

Continual study is being given in Agriculture to ways and means of simplifying this process. This becomes increasingly important as the size of our program increases. I believe the recommendation of the President's Scientific Research Board to set up a special unit in the Budget Bureau to handle all research budgets should result in better and more sympathetic consideration of research requests. I should

like to suggest that the key men on this staff be scientists in their own right. In addition, I should like to see within such an agency a small, well-staffed unit that would concern itself entirely with devising ways and means of simplifying and improving the budget process as it relates to research activities.

Another phase of budgetary management was discussed by the Board, and I will quote from its report:

> Current appropriations for scientific research and development in Government laboratories are almost exclusively on a 1-year basis, but few of the Government's research programs can be planned wisely or appraised sensibly in terms of less than 3, 5, or even 10 years of work. . . . All research programs should be presented to the Bureau of the Budget and to congressional appropriation committees on the basis of their long-term ultimate objectives and appropriations should be granted for that part of the program to be undertaken in the next fiscal period. In other words, a program should be projected 3 to 10 years in the future. The projected program should be reviewed, modified to meet changed conditions, and approved each year by the Bureau of the Budget, and Congress.

In concluding this brief statement of some of the problems involved in the administration of the many and diverse programs of Federal research, I should like to restate what I consider to be several essentials to the successful administration of such a program:

(1) The program must be organized to give the greatest freedom and latitude possible within Federal laws and regulations to the scientific staff. This staff is the key to the success or failure of any research program. The staff members not only should have the greatest possible freedom of expression and publication consistent with security needs, but should be given the greatest encouragement to participate in the planning and development of all programs.

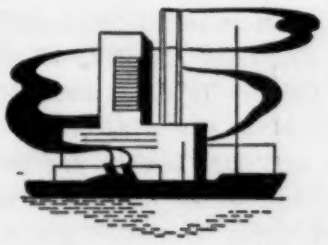
(2) The Administrator must encourage teamwork on the part of the scientific staff to obtain results quickly and at least cost. With increasing specialization in science and the pressure to reduce expenditures in Government, this problem must be given more and more attention.

(3) It is necessary that each research agency undertake research on and solve those problems that are of greatest importance to the constituency it serves. Therefore, good relationships must be developed with industry, scientists, and others in order to make possible the best choice of problems.

(4) The Administrator must be sympathetic to basic as well as applied research and must organize his program to allow a large part of the efforts of his research staff to be devoted to the solution of basic or fundamental problems. The President's Scientific Research Board has recommended that the scope of this type of research be increased fourfold by 1957. Provision of opportunities for basic research sometimes requires fortitude on the part of the Administrator in the face of pressure for the solution of the many urgent problems confronting an industry. In the final analysis, however, progress will depend on a continuing flow of new concepts and facts from such research. Each research unit must give increasing attention to its basic research program.

(5) In the interest of securing maximum results from each dollar appropriated for research, each agency must give increasing thought to eliminating "red tape" and "paper pushing." Much has been done in this direction, but I believe that with systematic, well-directed effort more can be accomplished. I am certain that all organizations are alert to this need.

Most of my remarks have dealt with the day-to-day chores of a research administrator. All of us who are engaged in any part of research can see to a greater or lesser extent the long-range implications of our work. Physical and biological science has accomplished miracles in lightening the burdens and prolonging the life of man. But it has advanced far beyond the social sciences. Man's knowledge is badly out of balance. We cannot stop at this point and turn back. The only hope of bringing it into balance and holding to the gains we have made is by pushing ahead on the weak side. We must not do it by holding back on the strong side.



NEWS and Notes

An Interdepartmental Committee on Research and Development, recommended by the President's Scientific Research Board last fall in its report, *Science and public policy,* and established last December by Executive Order, has now been constituted. Last Saturday President Truman appointed Alexander Wetmore, secretary of the Smithsonian Institution, chairman of the Committee. Dr. Wetmore will be assisted by Thomas B. Nolan, assistant director, U. S. Geological Survey (vice-chairman); James B. Fisk, director, Division of Research, AEC; E. U. Condon, director, National Bureau of Standards; Mary E. Switzer, assistant to the administrator, Federal Security Agency; Hugh L. Dryden, director of aeronautical research, NACA; W. V. Lambert, administrator of research, Department of Agriculture; J. E. Graf, assistant secretary, Smithsonian Institution (deputy for Dr. Wetmore); E. H. Cushing, assistant medical director for research and education, Veterans Administration; Maj. Gen. Henry S. Aurand, director of service, supply, and procurement, General Staff, Department of the Army; Maj. Gen. A. C. McAuliffe, deputy director for research and development, Department of the Army (deputy for Gen. Aurand); Maj. Gen. L. O. Craigie, director of research and development, Department of the Air Force; L. R. Hafstad, executive secretary, Research and Development Board; and Rear Adm. P. F. Lee, chief of naval research, Department of the Navy. The Committee's functions will include making recommendations leading to increased efficiency of Federal research and development programs and reporting on "current policies and administrative practices relating to Federal support for research, such as grants and contracts for basic research." The group has also been asked to seek advice of persons outside the Federal Government and "to propose means by which information relating to the status and results of scientific research undertaken by Federal agencies can be most effectively disseminated."

About People

Arthur Stanton Adams, provost of Cornell University, has been named 11th president of the University of New Hampshire. Dr. Adams succeeds **Harold W. Stoke,** who resigned last August to accept the presidency of Louisiana State University. Dr. Adams, wartime administrator of the Navy V-12 training program, will assume his new duties in a few months.

Alfred Blalock, professor of surgery, Johns Hopkins University School of Medicine, will deliver the 24th Lewis Linn McArthur Lecture of the Frank Billings Foundation, Institute of Medicine of Chicago, on February 27. Dr. Blalock will speak on "The Surgical Treatment of Congenital Cardiovascular Defects."

Sidney P. Colowick, associate in the Division of Nutrition and Physiology, Public Health Research Institute, New York City, has been appointed associate professor of biological chemistry at the University of Illinois College of Medicine, effective April 1.

Joseph B. Reynolds, head of the Department of Mathematics, and **Fred V. Larkin,** head of the Department of Mechanical Engineering, Lehigh University, will both retire on July 1. Dr. Reynolds has been associated with the University for 41 years and Dr. Larkin for 36 years. Their successors have not yet been named.

Vladimir Vesselovsky, who is currently teaching general chemistry at Rutgers University, Newark, New Jersey, has been appointed associate professor of physical chemistry at the University of Pittsburgh, beginning on June 1.

Kenneth E. Damann, formerly chief filtration bacteriologist of the City of Chicago, has joined the staff of the Department of Botany at Eastern Illinois State College, Charleston, where he is in charge of courses in bacteriology and microbiology and is assisting in courses in general botany.

Harold E. Clark, formerly biochemist at the Pineapple Research Institute, Honolulu, Hawaii, has been appointed associate professor of plant physiology and associate research specialist, Rutgers University and the New Jersey Agricultural Experiment Station, New Brunswick, New Jersey.

Wilbur R. Varney, instructor of metallurgy and metallography, Lafayette College, has been appointed assistant professor of mechanical engineering at California Institute of Technology.

George Henry Penn, recently a Lieutenant in the U. S. Navy, has been appointed assistant professor of zoology, Biology Department, Tulane University.

James T. Grady, managing editor, American Chemical Society's News Service, for 25 years, retired December 31. The Board of Directors of the Society cited the "significant contribution he has made to the better public understanding of chemists and chemical engineers, and their contributions to public welfare." Mr. Grady, who will continue with the Society in an advisory capacity, has been succeeded by **James H. Stack,** assistant managing editor since 1945.

C. West Churchman, of the philosophy staff, University of Pennsylvania, has been named associate professor of philosophy at Wayne University.

Robert Muir, who is on the staff of Pomona College, will go to the State University of Iowa around July 1 as assistant professor of botany.

Richard Bellman, assistant professor of mathematics, Princeton University, will join the faculty of Stanford University in the fall as associate professor. During the war Dr. Bellman participated in the Los Alamos atom bomb project.

Harold Scarborough, Rockefeller Medical Fellow who is at present working in the Physiology Department, Harvard University, has been appointed lecturer with the title of reader in the Department of Medicine (W. Melville Arnott), University of Birmingham, England.

Jorge Ancizar-Sordo, director, Laboratorio Químico Nacional, Bogotá, Colombia, has been named to represent Colombia chemists on the Colombian National Commission for UNESCO.

Philip Franklin, professor of mathematics, Massachusetts Institute of Technology, during the current spring term is also serving as visiting lecturer on mathematical physics at Harvard University.

Visitors to U.S.

Arnold J. Toynbee, British historian, and **Niels Bohr,** Danish physicist, have accepted appointments to the Institute for Advanced Study. Dr. Toynbee, professor of history at the University of London, will continue research for his 9-volume work, *A study of history,* while Dr. Bohr, 1922 Nobel Prize winner, will continue his work on elementary particle physics.

Georges J. Boné, Institut de Medicine Tropicale, Antwerp, Belgium, is spending several months at the Physiological Laboratory, University of California, on a fellowship of the Belgian-American Education Foundation. He is accompanied by his wife, Dr. Liliane Boné.

Two Czechoslovakian chemists arrived in this country on January 25 for 6 months of advanced study under grants provided from a $25,000 fund donated to UNESCO by the American Chemical Society. The two UNESCO Fellows, both 28 years old, are Ivan Vavruch, chief chemist of a government beet-sugar factory at Cerekvice, who will study colloid chemistry at Massachusetts Institute of Technology, and Milos Hudlicky, assistant at the Institute of Organic Chemistry in Prague, who will specialize in fluorine chemistry at Ohio State University. Chemists and chemical engineers from China, Greece, Poland, and the Netherlands are also expected to arrive soon under terms of the ACS grants. The fund is administered by the Institute of International Education, which aids the ACS in choosing candidates and planning curricula.

Fellowships

Prospective workers in the field of tissue culture may now apply for National Institute of Health fellowships at the bachelor, master, or post-doctorate level. The fellowships will enable the recipients to spend part of one academic year for supervised training at a tissue culture laboratory, with the balance of the tenure devoted to observation at research laboratories or in participation in a summer course of lectures and laboratory dealing with tissue culture methods. Research in fields other than cancer is welcomed, and fellowships are open to Tissue Culture Commission workers in the United States, Canada, and other foreign countries, and their assistants. Application forms, obtainable from the Division of Research Grants and Fellowships, National Institute of Health, Bethesda 14, Maryland, should be submitted to C. J. Van Slyke, chief of the Division.

The National Tuberculosis Association is offering a number of teaching and research fellowships in the field of tuberculosis. Limited to graduates of American schools for teaching and investigation in the United States, the fellowships carry annual stipends of $2,400–$3,200, with provisions for laboratory fees and incidental expenses. While not restricted to applicants with Ph.D. or M.D. degrees, preference will be given these applicants. Applicants may choose their own institutions for study in the fields of pathology and bacteriology, clinical medicine, epidemiology, and social and statistical research. Inquiries regarding the fellowships may be obtained from James E. Perkins, Managing Director, National Tuberculosis Association, 1790 Broadway, New York 19, New York.

Colleges and Universities

The University of Illinois is now constructing a new chemistry and chemical engineering building which is expected to be one of the best-equipped laboratories of its kind. The laboratory now under construction, 205 feet long and 125 feet wide, is only one unit of what will eventually be a chemistry and chemical engineering plant occupying an entire block. The building, to be erected at a cost of approximately $2,500,000, will provide 120,000 square feet of floor space, and will be equipped with elaborate ventilation machinery on the basement and top floors. Features of the building will include grilled spaces on all floors above the ground floor, which will permit installation of experimental equipment up to 80 feet in height. Another of the main features will be a chemical engineering unit operations laboratory, a large room in the center of the main floor, three floors high, which will have balconies in the room providing operating levels of 9, 18, and 27 feet. A 12-foot bay across the center of the main floor will allow trucks to be driven directly into the laboratory, and a traveling crane will handle the moving of heavy equipment. The Chemical Engineering Division will occupy the ground and first two floors, while the Biochemistry Division will occupy the third and fourth floors.

Harvard University's Seismograph Station has announced installation of a new seismograph, one of the first recordings of which was the January 24 earthquake in the Philippine Islands. Designed by Roland K. Blumberg, a graduate student in geology at Harvard, the new device records horizontal motion in the north-south and east-west directions as well as vertical motion. One of the most valuable features of the new seismograph is that it presents its record on a ticker tape which can be located in the seismologist's office, obviating

the photographic processing necessary for observation with the older machines.

The effects of "trace" elements upon plants, animals, and man are to be studied at Johns Hopkins University under terms of a gift of $500,000 from one of its Trustees, John Lee Pratt, of Fredericksburg, Virginia. Income from the gift, to be known as the McCollum-Pratt Fund (named for the donor and E. V. McCollum, authority on nutrition at the University), will provide an annual budget of about $60,000 for a 10-year period. An interdepartmental committee will advise on selection of suitable personnel and guide the project. The departments and their representatives initially concerned are Biochemistry (Dr. McCollum), Geography (Robert L. Pendleton), Sanitary Engineering (Abel Wolman), and Preventive Medicine (Perrin H. Long). George F. Carter, chairman, Department of Geography, will serve as secretary of the advisory group pending assembly of a special staff. Ultimate purpose of the long-range study is improved human health. In discussing the gift and its implications, President Bowman stated that one of the objectives is publication of a yearbook which will contain the most promising papers in trace-element research and thus benefit research staffs everywhere.

The Mechanical Engineering Department, Polytechnic Institute of Brooklyn, will inaugurate a new graduate course in "Design of Oil Power, Hydraulics and Control" in the spring semester. First of its kind ever presented by an engineering school in this country, the new course will introduce a precise mathematical formula for machinery design, and will offer oil men and mechanical engineers a theoretical basis for the various means of generating, transmitting, and utilizing oil power by fluid motors. The course will be presented by Ernest Midgette, head of the Department of Mechanical Engineering.

Southwestern Medical College was recently assured additional facilities for its expanded cancer research program. The U. S. Office of Education in Fort Worth has approved construction of a temporary laboratory to house facilities of the Biophysics Department, headed by Allen F. Reid, former director of Columbia University's chemical and radioactivity research for the Manhattan Project in New York City. Announcement of additional facilities for Southwestern's cancer research program coincides with the recent grants of $100,000 donated for this work (*Science*, January 2, p. 10).

The Stanford Research Institute has recently undergone several personnel changes. Following the resignation last month of William F. Talbot, who had directed the Institute since September 1946, William E. Rand, assistant director since early in 1947, was made acting director. Another resignation was that of T. L. Swenson, head of the food technology section, who is to engage in commercial laboratory consulting work in the Pacific Northwest. Ronald Scantlebury, former physiologist and pharmacologist on the University of Arkansas Medical School faculty, has joined the staff. Dr. Scantlebury, in addition to carrying on physiological research dealing with the Smog investigation being made at the Institute, will handle the physiological aspects of research in the Food Acceptance Laboratory.

Industrial Laboratories

William A. Adamson, who has been associated with the Du Pont Company for the past 30 years, retired on February 1. Dr. Adamson had much to do with early developments in the fields of basic, alizarine, and anthraquinone vat dyes.

Samuel E. Sheppard, assistant director of research, Eastman Kodak Company, and a member of its staff since 1913, retired January 1. Dr. Sheppard is noted for his work ranging from research on gelatin and sensitizing dyes to studies of the size of grains in photographic emulsions.

W. E. Hanford, chemist, has recently been appointed to the newly created post of director of petroleum and chemical research, M. W. Kellogg Company. Prior to joining the organization in October of 1946 Dr. Hanford had been director of research for the General Aniline & Film Corporation. In his new position he will have charge of all laboratory work at the Jersey City plant and that performed under university fellowships.

R. J. Allgeier, who joined U. S. Industrial Chemicals, Inc., in 1940, has been made manager of fermentation research. He has been associated with research and development work connected with the fermentation industry for the past 18 years.

L. O. Grondahl writes that, as of last October 1, he became consultant in research to the Westinghouse Airbrake Company and the Union Switch and Signal Company. He formerly served as director of research and engineering for the Union Switch and Signal Company.

Summer Programs

The second summer research program for the Jackson Hole Wildlife Park has been announced by the New York Zoological Society. Limited grants-in-aid are available up to $500, to qualified graduate students and individuals who are professionally established, for research in ecology, conservation and land use, wildlife, life history studies, behavior, botany, ornithology, entomology, pathology and parasitology, and aquatic biology. Information and application blanks may be obtained from members of the committee in charge of the program: J. R. Simon, Moran, Wyoming, chairman; C. R. Carpenter, Pennsylvania State College; W. W. Chase, University of Michigan; and R. K. Enders, Swarthmore College.

Conditions resulting from the disastrous fire on Mt. Desert Island are rapidly being restored to order, and according to J. P. Scott, chairman of the Summer Investigators' Committee, the Roscoe B. Jackson Memorial Laboratory will run its Summer Research Program on as nearly normal a basis as possible. For the past several years research facilities have been offered to a number of investigators in the general fields of (1) growth and genetics

related to cancer and (2) comparative psychology and sociobiology as related to psychosomatic medicine. Facilities in the latter field were not damaged by the fire and will be, in fact, somewhat enlarged during 1948. Applicants in either field should write to the Laboratory as soon as possible.

The Summer School Training Program for undergraduate and predoctoral students has been greatly assisted by a recent gift by the Ladies' Auxiliary of the Veterans of Foreign Wars. This gift makes possible the restoration of the summer school buildings on a larger and better scale, and as many students as possible will be accommodated during the coming summer.

Meetings and Elections

Ten world medical and research authorities on poliomyelitis have been named presiding officers for plenary sessions of the First International Poliomyelitis Conference, to be held in the Waldorf-Astoria Hotel, New York City, July 12–17. Simultaneously, subjects of the sessions were announced by Hart E. Van Riper, medical director of the National Foundation for Infantile Paralysis, who is general chairman of the Conference.

Each of the presiding officers will be assisted by a panel composed of international authorities who have done special work on particular phases of the problem. Papers on polio will be presented at each session and will be followed by open discussions. Summaries of polio problems in other countries will be presented by official delegates who have been invited to represent their governments. Invitations have been extended through the State Department to more than 60 nations. In addition, some 20 other medical and scientific authorities from abroad will participate in the program.

Delegates to the Conference will be divided into three categories: official government delegates; institutional delegates representing invited universities, societies, and scientific and philanthropic organizations interested in research and treatment of virus diseases; and member delegates. The last group will include physicians and other scientific and professional persons qualified by recognized standards.

Dr. Van Riper noted that "work must be done on an international scale to teach a higher degree of comparability of all problems presented by the disease, its treatment and research," adding that "collection of local detailed epidemiological and immunological studies from all parts of the world and correlation of such studies has never been accomplished on the necessary scale before. . . . It is planned that this conference will serve as a means of expediting distribution of vital knowledge on a world-wide basis."

Plenary session presiding officers and subjects include: Oswaldo P. Campos, clinical orthopedic surgeon, Hospital Jesus, Rio de Janeiro, Brazil, "The Importance of Poliomyelitis as a World Problem"; Rustin McIntosh, professor of pediatrics, Columbia University, "Poliomyelitis: The Early Stage"; Robert Kno-Song Lim, Surgeon General, National Defense Medical Center, Shanghai, China, "The Management of Poliomyelitis: The Early Stage"; Arthur Steindler, professor of orthopedic surgery, State University of Iowa, "Poliomyelitis: The Convalescent Stage"; Arvid Wallgren, professor of pediatrics, Royal Caroline Medical Institute, Stockholm, Sweden, "The Management of Poliomyelitis: The Convalescent Stage"; Carlos S. Ottolenghi, Docente Libre de Ortopedia, Buenos Aires, Argentina, "The Management of Poliomyelitis: The Late Stage"; James E. Paullin, professor of clinical medicine, Emory University, "Bulbar Poliomyelitis"; Pierre L. LePine, director of laboratories, Pasteur Institute, Paris, France, "Immunology and Chemotherapy in Poliomyelitis"; Harry S. Mustard, Commissioner of Health, New York City, "The Public Health Aspects of Epidemic Poliomyelitis"; and Thomas Parran, Surgeon General, U. S. Public Health Service, "Poliomyelitis Throughout the World." Official government delegates will present reports on poliomyelitis problems in their countries at this session.

The plenary sessions will be preceded by the opening meeting presided over by Irvin Abell, clinical professor emeritus of surgery, University of Louisville. Delegates will be welcomed by Basil O'Connor, president of the National Foundation for Infantile Paralysis, and foreign delegates will be introduced by Morris Fishbein, editor of the *Journal of the American Medical Association.*

The Conference is being held under the auspices of the National Foundation for Infantile Paralysis, with the cooperation of the following scientific societies and U. S. Government agencies which have endorsed the program: Department of State; Office of the Surgeon General, Department of the Army; Bureau of Medicine and Surgery, Department of the Navy; U. S. Public Health Service, U. S. Children's Bureau, and Veterans Administration; American Academies of Orthopedic Surgeons and of Pediatrics, American Association of Pathologists and Bacteriologists, American College of Physicians, American College of Surgeons, American Congress of Physical Medicine, American Heart Association, American Medical Association, American Pediatric Society, American Physiological Society, American Physiotherapy Association, American Public Health Association, Association of Military Surgeons of the United States, Federation of American Societies for Experimental Biology, National Research Council, National Society for Crippled Children and Adults, and Western Surgical Associations.

Among the many distinguished professional authorities from abroad who will participate in the program are: H. J. Seddon, medical director, Wingfield-Morris Orthopedic Hospital, Oxford, England; J. H. S. Gear, South African Institute for Medical Research, Johannesburg; Herman Romero, professor of health, University of Chile, Santiago; S. van Creveld, professor of pediatrics, University of Amsterdam, The Netherlands; Fritz Buchtal, Universitatets, Neurofysiologiski Institut, Copenhagen, Denmark; Juan Farill, acting president, International Society for the Welfare of Cripples, Mexico City; Alfonso Montagne, Lima, Peru; Sven Gard, professor of bacteriology, Statens Bakteriologiska Laboratorium, Stock-

holm, Sweden; G. Paredes, minister of public health, Republic of Panama; and L. N. Silverthorne, Hospital for Sick Children, Toronto, Canada.

A Symposium on the Physiology and Biochemistry of Lipids was held at the Sorbonne, Paris, January 5–12, in the laboratory of G. Schaeffer, professor of general physiology. President of the Symposium was E. F. Terroine.

E. Chargaff, of the College of Physicians and Surgeons, Columbia University, has reported that the 9-part program included: Digestion and Intestinal Absorption of Fat, P. Desnuelles, A. C. Frazer, M. Maudet, E. Le Breton, J. Rouzier, P. E. Verkade, and F. Verzar; Deposition and Mobilization of Fat, T. Cahn, G. Clément, and A. Houget; Lipoprotein Complexes in the Blood and Tissues, E. Chargaff, A. C. Frazer, E. Le Breton, and M. Macheboeuf; Metabolism of Higher Fatty Acids, R. H. Barnes, K. Bernhard, S. Gurin, and P. E. Verkade; Metabolism of Essential Fatty Acids, R. H. Barnes, K. Bernhard, J. Clément-Champougny, and E. Le Breton; Lipids and Blood Coagulation, E. Chargaff; Phospho-amino Lipids and Degradation Products, S. Bouchilloux, J. Clément-Champougny, P. Fleury, M. Kahane, E. Le Breton, J. Levy, and J. Roche; Oxidation of Fats *in Vitro*: Anti-oxidases, R. H. Barnes, A. Chevallier, P. Dubouloz, and C. Paquot.

The proceedings will appear in full in the *Archives des Sciences Physiologiques*, published by the Centre National de la Recherche Scientifique, sponsors of the Symposium. The Rockefeller Foundation supplied financial support for this Symposium.

The Board of Governors of the Arctic Institute of North America, at a meeting in Toronto on February 6, elected Henry B. Collins, Jr., Bureau of American Ethnology, Smithsonian Institution, chairman; J. J. O'Neill, dean of the Faculty of Engineering, McGill University, vice-chairman; Richard Foster Flint, professor of geology, Yale University, secretary; and G. Gordon Bell, Ottawa, treasurer. Permanent officers of the Institute are A. L. Washburn, executive director; Sir Hubert Wilkins, assistant to the chairman; P. D. Baird, director of the Montreal office, 805 Sherbrooke Street West; and Walter A. Wood, director of the New York office, Broadway at 156th Street.

The meeting was followed by a reception given by V. Ignatieff, warden of the University of Toronto, and a dinner given by the president of the University, Sidney Smith, for the governors and officers of the Arctic Institute, members of the University faculty, and others interested in the Arctic. At the dinner J. B. Tyrrell, one of four distinguished scientists and explorers who had been elected to honorary membership, was presented with a specially designed framed certificate. The three other honorary members are Rear Adm. Richard E. Byrd, Lincoln Ellsworth, and J. M. Wordie, University of Cambridge.

The Institute has recently extended its membership to include a class of Charter Associates, to which it invites all who wish to associate themselves with the objectives of the Institute—to encourage and support basic scientific research in the Arctic and sub-Arctic regions of North America.

Sigma Delta Epsilon held its National Convention in Chicago on December 29, at which time the following officers were elected for 1948: Winona Welch, DePauw University, president; Pearl Claus Whitehead, University of Wisconsin, 1st vice-president; Harriet Creighton, Wellesley College, 2nd vice-president; Frances Lloyd Naylor, 102 Seymour Road, Woodbridge, Connecticut, secretary; Agnes Hansen, University of Minnesota, treasurer; and Lela V. Barton, Boyce Thompson Institute, Mary L. Willard, Pennsylvania State College, Hettie M. Chute, New Jersey College for Women, Hoylande Young, Argonne National Laboratory, and Stella M. Hague, Auburn, Indiana, members of the Board of Directors.

The luncheon for all women in science, held at the Hotel Sherman on December 28, was attended by 95 members and guests. Margery Carlson, of the Department of Botany, Northwestern University, spoke to the group on "Plant Collecting in Salvador," illustrating her lecture with excellent Kodachrome slides.

The Mycological Society of America, at its recent annual meeting in Chicago, elected Julian H. Miller, University of Georgia, president; F. K. Sparrow, University of Michigan, vice-president; Joseph C. Gilman, Iowa State College, secretary-treasurer; J. A. Stevenson, U. S. Department of Agriculture, Ralph Emerson, University of California, and A. J. Mix, University of Kansas, councilors; and G. D. Darker, Ben Venue Laboratory, Inc., Bedford, Ohio, AAAS representative.

The Genetics Society of America recently elected L. H. Snyder, University of Oklahoma, president; T. M. Sonneborn, Indiana University, vice-president; and M. R. Irwin, University of Wisconsin, to continue as secretary-treasurer.

The Limnological Society of America held its 10th annual meeting December 29–31, 1947, in conjunction with the meetings of the AAAS in Chicago. George L. Clarke, of Harvard University, secretary-treasurer of the Society, reports that the 6 half-day sessions at which papers were presented were very well attended. A symposium on "Limnological Aspects of Water Supply and Waste Disposal," sponsored jointly with Section M (Engineering), AAAS, was held on December 30, and on the morning of December 31 the Limnological Society and the Ecological Society of America met jointly in a symposium on "Bottom Sediments." An item of especial interest for this meeting of the Society was a conducted tour of the new Chicago filtration plant, following the Tuesday afternoon session. This tour made it possible for the group to gain an idea of the elaborate chemical, mechanical, and bacteriological treatments which have been developed and to see the newly prepared testing and research laboratories.

At the business meeting of the Society, G. E. Hutchinson, Yale University, was elected president, and L. T. Wilson, Heidelberg College, vice-president. Dr. Clarke continues as secretary-treasurer.

The Oregon Academy of Science held its 6th annual meeting at Willamette University, Salem, on January 17. Warren D. Smith, Eugene, was elected president, and W. E. Milne, Corvallis, vice-president (president-elect). Pierre Van Rysselberghe, Eugene, was re-elected treasurer, and F. A. Gilfillan, Corvallis, retains the office of secretary for one more year of a two-year term.

A total of 34 papers were listed for the four sections which have been organized. Chairman of these sections for 1948 are: Biology, Paul L. Risley, Eugene; Chemistry, Joseph Schulein, Corvallis; Geology-Geography, Herman Clark, Salem; and Mathematics, A. F. Moursund, Eugene.

The Ecologists Union, a newly formed organization "devoted to the preservation of natural biotic communities for scientific use," adopted a permanent constitution at the recent Chicago meetings of the AAAS. The first full slate of officers was elected as follows: president, Lee R. Dice, University of Michigan; vice-president, A. O. Weese, University of Oklahoma; secretary-treasurer, Ralph W. Dexter, Kent State University; members at large on the Board of Governors, V. E. Shelford, University of Illinois; R. F. Daubenmire, State College of Washington; and H. I. Baldwin, Fox Research Forest, New Hampshire. S. Charles Kendeigh is chairman of the Committee on the Study of Plant and Animal Communities, and Curtis L. Newcombe is chairman of the Committee for the Preservation of Natural Conditions. S. Charles Kendeigh served as general chairman and Harold M. Hefley, University of Arkansas, served as secretary-treasurer during the period of organization.

NRC News

At the request of U. S. Naval authorities, the NRC, in July 1947, appointed an Insect Control Committee for Micronesia (ICCM) under the Pacific Science Board. Scientific investigations of the insect problems designated by the Committee for special research are being carried out by the Board with funds granted by the Office of Naval Research. This newly formed Committee, which will advise and assist the administration of the Trust Territory of the Pacific Islands, includes: C. E. Pemberton, executive entomologist, Hawaiian Sugar Planters' Association, Honolulu, chairman; Harry S. Smith, head, Division of Biological Control, University of California, Riverside; C. P. Clausen, chief, Division of Foreign Parasite Introduction, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, D. C.; and the staff entomologist of the Deputy High Commissioner of the Trust Territory of the Pacific Islands, Guam. The Honolulu officer of the Pacific Science Board, Edwin H. Bryan, Jr., is the secretary.

At the initial meeting of the Committee held in Honolulu, September 30–October 2, 1947, several recommendations were made regarding quarantine, control of insect pests, and the entomological investigations in Micronesia. These were accepted and approved by the High Commissioner of the Trust Territory and are being carried out. Transportation for this program is being furnished by NATS, and other facilities are being supplied by the Department of the Navy.

In the Trust Territory Daniel B. Langford, who has been entomologist with the U. S. Commercial Company, has recently been appointed staff entomologist, and Kenneth L. Maehler, on loan from the Bureau of Entomology and Plant Quarantine, Department of Agriculture, has been appointed quarantine officer.

Five field associates in entomology of the Pacific Science Board are carrying out the field research program of the ICCM. Theodore R. Gardner, on loan from the Bureau of Entomology and Plant Quarantine, spent the period from October 13 to November 10 in the Palau Islands, surveying the distribution and abundance of, and destruction to, coconut palms caused by the rhinoceros beetle, *Oryctes rhinoceros.* He is now in Malaya in search of parasites to help control this beetle. W. Harry Lange, on loan from the Agricultural Experiment Station, University of California, spent the period from October 14 to November 12 making a study of the Mariana coconut beetle, *Brontispa mariana,* and the giant African snail, *Achatina fulica,* in Saipan, Tinian, and Rota Islands of the Marianas. He also is in Malaya in search of natural enemies of the Mariana coconut beetle. Henry Dybas, on loan from the Chicago Natural History Museum, is making an entomological survey of the Palau Islands, after which he will also collect insects in other Caroline Islands. F. X. Williams, formerly associate entomologist with the Hawaiian Sugar Planters' Association, is in Kenya Colony, Africa, studying the life history of the giant African snail and searching for its natural enemies. Harold Compere, of the Division of Biological Control, University of California, is shipping *Scolia* wasp parasites from Zanzibar, which are being liberated in Palau to help control the rhinoceros beetle there.

Prior to the initial meeting of the Committee, through the efforts of one of its members, predacious beetles, *Plaesius javanus,* supplied by the Department of Agriculture, Suva, were successfully introduced from Fiji to Guam and liberated as natural enemies of the banana root borer, *Cosmopolites sordidus.*

Elwood C. Zimmerman, of the staff of the Hawaiian Sugar Planters' Association and the Bernice P. Bishop Museum, Honolulu, and Joseph C. Bequaert, curator of insects, Museum of Comparative Zoology, Harvard University, have been appointed consultants to the ICCM. Edwin H. Bryan, Jr., secretary of the Committee, has established a document research program at the Honolulu office of the Pacific Science Board, in the Bernice P. Bishop Museum, to support and assist the field entomologists.

Representatives of the U. S. Department of Agriculture, Departments of the Navy and Interior, the U. S. Commercial Company, the Board of Agriculture and Forestry of the Territory of Hawaii, the Hawaiian Sugar Planters' Association, the Pineapple Research Institute, the Hawaiian Agricultural Experiment Station (University of Hawaii), and the Bernice P. Bishop Museum were present at the Honolulu meeting of the Committee.

Deaths

Henry Frank Moore, 80, former United States Deputy Commissioner, Bureau of Fisheries, died in Linville Falls, North Carolina, on January 8.

Ralph Gordon McCurdy, 56, inventor and director of transmission apparatus development for the Bell Telephone Laboratories, died at his home in Montclair, New Jersey, January 10.

Ludwik Silberstein, 75, physicist and authority on the theory of relativity, died January 17 of a heart attack in Rochester, New York.

Alva W. Smith, 62, professor of physics at The Ohio State University and a member of its faculty for 33 years, died suddenly of a heart attack, January 21, at his home in Columbus, Ohio.

George F. Bateman, 61, dean of the School of Engineering, Cooper Union, died suddenly in New York on January 29.

Josiah Kirby Lilly, 86, board chairman, Eli Lilly & Company, pharmaceutical manufacturers, died February 8 after a long illness.

The Arctic Institute of North America announces publication of *Journal of the Arctic Institute,* beginning in March. The new journal, which will provide information about the Arctic and Subarctic areas of Alaska, Canada, Greenland, and Labrador, will include scientific articles prepared for the nonspecialist, together with notes and news of events in northern North America. Trevor Lloyd will edit the new magazine. Inquiries about the new journal may be addressed to the Institute at Audubon Terrace, Broadway and 156th Street, New York 32, New York.

The John Frederick Huckel Collection of 111 Navaho sand paintings was presented last month to the Colorado Springs Fine Arts Center by Miss Katherine Harvey, of Santa Barbara, California, in memory of her uncle and aunt, the late Mr. and Mrs. John Frederick Huckel, of Kansas City. These paintings, now available for study, were made between 1902 and 1924. Gladys A. Reichard, associate professor of anthropology, Barnard College, states that many are concerned with the Shooting, Mountain, and Wind chants, while others are associated with some of the Navaho chants, now rarely sung.

Arnhem Land, a corner of northern Australia populated by natives who have never developed the bow and arrow, will soon be visited by a group of scientists on an expedition sponsored by the National Geographic Society, the Smithsonian Institution, and the Commonwealth of Australia. Throughout the dry season, which normally extends from March to October, members of the expedition will study the primitive natives and the mammal, bird, fish, insect, plant, and marine life of the region. Approach to the reserve will have to be made by small schooner, and the journey inland will be a difficult one. The terrain varies from deep watercourses to rocky bluffs, and the many bays and estuaries are infested with reptiles and insects.

Leader of the expedition will be Charles Pearcy Mountford, ethnologist of the South Australia Museum at Adelaide. U. S. scientists who will join the leader in Sydney include Frank M. Setzler, David H. Johnson, Herbert G. Deignan, and Robert R. Miller, all of the Smithsonian Institution, and Harrison H Walker, National Geographic staff-writer photographer who has had several years of Australian experience.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, Illinois, announces the following wanted chemicals: phosphatase, thiocytosine, 2,6-diisopropyl-p-cresol, ethyl vanillate, N-methylnipecotic acid, scopoletin, undecyl aldehyde, chromium hexachloride, hordenine, hemipinic acid, cuscohygrine, disodium acetylide, acenaphthylene, glucoascorbic acid, montanic acid, thyroglobulin, silicon xanthates, keto methionine, hexahydrobenzaldehyde, and 2-pyrrole aldehyde.

Letters from A. Vatova and Jovan Hadzi, written last year to John L. Mohr, Department of Zoology, University of Southern California, contained news of biological institutions along the Adriatic. The staff of the former Istituto Italo-Germanico di Biologia Marina, Rovigno d'Istria, left the institution, the director, A. Vatova, now being stationed at Venice with the Comitato Talassografico Italiano. The station located at the port now known as Rovinj in Croatian Istria, a part of Yugoslavia, is to be reopened this year for fisheries work. The Institute of Oceanography and Fisheries at Split (Spalato) is "very active" under its director, Tonko Šoljan.

The U. S. Atomic Energy Commission has announced publication of *Lecture series in nuclear physics,* comprising a group of lectures originally given in 1943 to aid in training Los Alamos personnel in the fundamentals of nuclear science. The series includes material by such experts as E. M. McMillan, E. Segré, E. Teller, F. Bloch, J. H. Williams, C. L. Critchfield, V. F. Weisskopf, and R. F. Christy. Copies may be obtained for $.55 from the Superintendent of Documents, Washington 25, D. C.

Make Plans for—

American Society of Mechanical Engineers, spring meeting, March 1-4, St. Charles Hotel, New Orleans, Louisiana.

American Society of Experimental Pathology, March 15–20, Atlantic City, New Jersey.

Ohio Society of Professional Engineers, March 18–20, Netherland Plaza Hotel, Cincinnati, Ohio.

Chicago Technical Conference, in conjunction with annual Chicago Production Show, March 22–24, Stevens Hotel, Chicago, Illinois.

American Society for X-Ray and Electron Diffraction and Crystallographic Society of America, April 1–3, Yale University, New Haven, Connecticut.

Comments and Communications

Mustard—Its Preparation and Use

Numerous articles are appearing in which results of laboratory tests with mustard are reported. A large part of this work was done with samples obtained from the Chemical Corps, but since the substance is easily made, it may be assumed that some experimenters have prepared samples for their own use. It should be emphasized that the laboratory preparation of mustard by the novice is a much more dangerous procedure than the laboratory use of small quantities in clinical research. The writer has observed many workers over a period of 20 years and can report that a very small fraction have avoided being burned when using the material in bulk. Because of this experience it is believed that the instructions for the laboratory preparation of mustard by Bent (*Science*, October 17, 1947, p. 374) are not quite adequate.

During the past year the Chemical Corps has refused to supply samples of mustard to a number of applicants, but has furnished instructions for its preparation and handling. Since it appears to be desirable to give this information wider distribution, it is presented elsewhere in this issue (p. 204) as a contribution by personnel of the Chemical Corps Technical Command.

In connection with the simplicity of the preparation of mustard from thiodiglycol, it is of interest to point out that the latter compound is now sold under the trade name of Kromfax solvent and that, although the advertising literature of the Carbide and Carbon Corporation advises the user not to add hydrochloric acid to it, no mention is made of the fact that mustard is the reaction product. More amusing still, the compound $(HOCH_2\text{-}CH_2)_2S_2$ is now sold by Thiokol Corporation under the name Thiokol SC–10, with the warning that hydrochloric acid should not be added to it, but, if it is, then the reaction product is only one-third as toxic as that obtained with the monosulfide, namely, Kromfax solvent. It is not clear why the advertising literature should so studiously avoid use of the name *mustard* when addressed to chemists.

R. Macy

Army Chemical Center, Maryland

Method for Changing Units

I was attracted by an article by F. L. Robeson, entitled "A Simple Method for Changing Units" (*Science*, October 10, 1947, p. 352).

While the author is justified in presenting his method as a simple one, a slight modification, which I have always used, appears to me to eliminate additional possible sources of confusion, such as memorized constants, fractions in numerator and denominator, etc.

Axiom: No value is changed upon multiplication by unity.

Rule: Units may be treated mathematically like numbers, *i.e.* they may be multiplied, divided, etc.

I trust that the author will not object when I cite his example to illustrate:

Given, the coefficient of thermal conductivity of glass:

$$k = 0.00250 \frac{\text{cal cm}}{\text{cm}^2\ {}^\circ\text{C sec}}$$

Required, k in terms of Btu per inch thickness per ft² per hr per °F.

Carrying out cross-multiplication by fractions having the value 1, we obtain:

$$k = 0.00250 \frac{\text{cal cm}}{\text{cm}^2\ {}^\circ\text{C sec}}$$

$$= 0.00250 \frac{\text{cal cm}}{\text{cm}^2\ {}^\circ\text{C sec}} \times \frac{1\ \text{Btu}}{252\ \text{cal}} \times \frac{1\ \text{in}}{2.54\ \text{cm}} \times$$

$$\frac{(30.48\ \text{cm})^2}{1\ \text{ft}^2} \times \frac{5\ {}^\circ\text{C}}{9\ {}^\circ\text{F}} \times \frac{3600\ \text{sec}}{1\ \text{hr}}$$

$$= 7.26 \frac{\text{Btu in}}{\text{ft}^2\ {}^\circ\text{F hr}}.$$

In addition to carrying out a direct slide-rule calculation, the worker can fix the position of the decimal immediately by inspection.

The above method is not applicable to calculus problems, in which the carrying of units is undesirable.

I feel happy to give credit for this method to one of my former instructors, the late E. Frenkel, who lost his life in a concentration camp in Holland during the German occupation of that country.

Burton H. Sanders

124–16 84th Road, Kew Gardens, New York

The "Polished Rocks" of Cornudas Mountain, New Mexico

Walter B. Lang, of the U. S. Geological Survey, has recently published two articles (*Science*, October 24, 1941, p. 390; January 17, 1947, p. 65) which may be paraphrased as follows: Some igneous boulders are found in the Hueco and Cornudas Mountains along the Texas-New Mexico boundary which exhibit highly polished patches near the edges or corners. These polished surfaces may be accounted for by their having been used by animals long extinct—possibly the cave bear or ground sloth—as places for rubbing and scratching their bodies. Minute particles of grease from their hides have become trapped within the outer fiftieth of an inch of the rock and may still be recovered by chemical reagents.

I believe that biological factors have had more effect in modifying the surface of the earth than is generally admitted. As a consequence, these two articles interested

me, since they purported to prove a biological cause of phenomena that would ordinarily have been attributed to sand-blast or water polish. I therefore made a trip in October 1947 to investigate.

Believing that the grease that Dr. Lang claims to have recovered from samples of rock chipped from the boulders might have come from something greasy such as a chisel, hammer, human hands, or the container in which the samples were transported, I took elaborate precautions to prevent contamination by grease of the specimens which I secured. I was skeptical of finding grease that was supposed to have been imprisoned in the rock for hundreds or thousands of years, but was hopeful of corroborating the biological explanation of the polished rocks.

Both of these groups of mountains receive their names from the relatively small intrusive masses of igneous rock which lie among much larger mountains of sedimentary rock strata which are, for the greater part, still horizontal. The USGS maps cannot differentiate between igneous and sedimentary mountains by contour alone. It is therefore surprising to come suddenly upon these jagged outcroppings among the terraced giants. "Hueco" is Spanish for "hollow" and refers to the window-like holes weathered in these rocks as well as to the caves formed by falling boulders. The name is now applied to the surrounding mountains as well. The Cornudas Mountains receive their name from "cornudo" or "bearing horns," which refers to the jagged summit of this small mountain. The Cornudas have weathered by the more conventional process of exfoliation.

Dr. Lang states that these intrusions are a porphyritic syenite injected into Permian strata. Weathering has freed iron which forms a coating over the surface of the rock, imparting a reddish-brown color.

The hydrous iron coating is only relatively smooth and cannot properly be termed "polished," but this type of surface is the smoothest to be found in the Huecos, either upon exposed surfaces or on the "hanging wall" of the caves where Dr. Lang reports having found it. He omits any mention of the Huecos in his second paper, although in a letter dated July 29, 1947, he stated: (At the Huecos) "you can see about everything that the Cornudas have to offer. . . ." Quoting from his second paper again, we find that the polished surfaces exist ". . . only on the southeast side of the Cornudas Mountain and only within a relatively narrow zone . . . at the base of the cliffs."

The Cornudas Mountain also has this black stain in places. The exfoliation gives the boulders a spotty appearance due to the scabby flaking. Search of the caves gave the same negative results as those of the Huecos. I did, however, find patches of polished rock around the southeast edge of the Cornudas. The first examples noted tallied pretty well with Dr. Lang's statements. These polished corners and edges appeared as if they might have been caused by some agency other than geophysical, but each example was definitely correlated with an ancient watercourse. Especially noted were a couple of cases where the polishing was *underneath* a ledge extending over solid rock. Here the polishing could have been done only by the back-scratching of an animal the size of a pig. Finally, a solid boulder was found resting upon bedrock. The under slope of this boulder was polished clear to its contact with the bedrock.

Neither the igneous Huecos nor Cornudas are surrounded by a detrital apron, but rise from a fairly smooth surface. Dr. Lang states: "I was surprised to see the same type of polished surface on the sides of large outlying boulders . . . which had broken loose from the high cliffs and had tumbled out upon the surrounding apron. . . ." No such igneous boulders were seen, but instances of large fragments were noted which had rolled from the thicker strata of sedimentary rock of the surrounding mountains and had come to rest upon their detrital aprons. These chunks did not bear any polished surfaces.

It is my belief that the polished surfaces are nothing more than stream scour such as is found in many watercourses. In this instance the scouring was accomplished so long ago that only fragments of polished surface remain, and these for the most part on sheltered aspects or on the harder rocks. The rainfall at the time of polishing must have been much greater than at present.

Under the circumstances I do not think it necessary to carry out tests upon the specimens which I secured to search for grease which could not have accumulated in the manner stated by Dr. Lang.

CHAPMAN GRANT

2970 Sixth Avenue, San Diego, California

Books for Korea

The generous response to my article on "Science Education in Korea" (*Science*, January 9, p. 31) is most gratifying to me and is of inestimable value to the scientists of Korea. Since many donors of books, magazines, and equipment wish to send their gifts direct, the following address is given: Bureau of Textbooks, Department of Education, USAMGIK, A. P. O. 235, Unit 2, c/o Postmaster, San Francisco, California.

GLENN A. NOBLE

California State Polytechnic College

TECHNICAL PAPERS

Factors Influencing the Mutation Rate in *Neurospora*[1]

HELMA MILLER and WILLIAM D. MCELROY

Department of Biology, The Johns Hopkins University

In a previous study (*2*) concerning the production of biochemical and morphological mutations in *Neurospora* by nitrogen mustard it was observed that 7- to 12-day-old conidiospores were relatively resistant to this agent. Since this point may be of some importance in analyzing the effect of various chemicals on mutation rate, we have investigated the relative susceptibility of various stages in the life cycle of *Neurospora* to this agent (*bis*-β-chloroethylmethylamine). The data from this study are summarized in Table 1.

TABLE 1

MUTATION RATE IN *Neurospora*—SENSITIVITY OF VARIOUS STAGES TO NITROGEN MUSTARD

Nitrogen mustard conc. (%)	Stage treated	Ascospores tested	Mutations*			Mutation rate (%)
			Morphological	Identified biochemicals	Unidentified biochemicals	
0.1	7- to 11-day-old conidia	1,137	1	0	0	< 0.1
0.1	2- to 3-day-old conidia	694	8	3	6	2.5
0.1	Germinating conidia (15%)	89	4	0	1	5.6
0.1	" " (67%)	412	14	3	8	6.1
0.1	" " (90%)	624	20	6	18	7.1
0.05	" " (90%)	606	9	1	7	2.8
0.1	Hydrated conidia	411	11	4	2	4.1
0.05	" "	176	4	1	1	3.4
0.1	Protoperithecia	237	6	3	10	8.0
0.05	"	534	23	10	10	8.0

*The identified biochemicals included those strains which required the following single components for growth: methionine, adenine, adenine or hypoxanthine, proline, thiamine, leucine, *p*-aminobenzoic acid, arginine, inositol, nicotinic acid, riboflavin, threonine, isoleucine, and lysine. The riboflavin mutant is temperature sensitive, apparently similar to the one reported by Mitchell and Houlahan (*3*). The unidentified biochemicals include those which grow on complete only but not on hydrolyzed casein or a synthetic vitamin mixture, on hydrolyzed casein but not on the individual amino acids, on the vitamin mixture but not on the individual vitamins, and poor on both complete and minimal. The morphological mutants include various colonial types such as cauliflower, button, rough, etc., and the color changes such as pink, brown, albino, yellow, etc.

The conidia were suspended in acetate buffer (0.2M, pH 6.0) and the mustard was added to give the desired concentration. At the end of 30 min, the sample was centrifuged, washed, and finally suspended in water. A few drops of the treated conidial suspension were then placed on protoperithecia of the opposite sex, and subsequently single ascospores were isolated from each perithecium. The ascospores isolated were tested for possible biochemical deficiencies according to the procedure of Beadle and Tatum (*1*). Since very young conidia (2–3 days) were found to be more sensitive than older ones, it was suspected that conidia just beginning to germinate might also be more susceptible. To test this, 12-day-old conidia were suspended in normal Fries solution and incubated at 29° C. Samples of the suspension were removed at 2, 4, and 6 hrs for treatment with the nitrogen mustard. Microscopic examination revealed that at 2 hrs, approximately 15% of the conidia had begun to germinate; at 4 hrs, 67%; and at 6 hrs, 90%. The conidial samples were then centrifuged and resuspended in 0.2M acetate buffer and treated as described above. The results in Table 1 indicate that germinating conidia are far more susceptible to the nitrogen mustard than are freshly suspended conidia of the same age. When conidia showing 90% germination were treated with 0.1% mustard, a mutation rate of 7% was obtained.

As control in the above experiment, a sample of the conidial suspension was placed at 8° C for the 6-hr period and subsequently treated with the mustard. No difference could be detected microscopically between freshly suspended conidia and those which had been hydrated for 6 hrs, *i.e.* no visible germination could be detected. However, the results indicate that these hydrated conidia are likewise sensitive to the mustard, a fairly good mutation rate being obtained with both 0.05 and 0.1% solutions. It is evident that, in some way, the degree of hydration of the spores is important in the induction of mutations by the nitrogen mustard. This may be related to the penetration of the compound or to the suppressed metabolic activity of the cell resulting from the dehydration. The fact that protoperithecia are extremely sensitive to the mustard, giving the highest and most consistent mutation rate, supports the earlier

[1] Supported in part by a grant from U. S. Public Health Service.

viewpoint that cells containing actively growing or dividing nuclei are more susceptible to the mutagenic action of various agents.

Regardless of the interpretation of the above facts, the results serve to point out the necessity of controlling the age and degree of hydration of conidia in studies concerned with the production of mutations by chemical agents.

References

1. Beadle, G. W., and Tatum, E. L. *Amer. J. Bot.*, 1945, **32**, 678.
2. McElroy, W. D., Cushing, J. E., and Miller, H. *J. cell. comp. Physiol.*, in press.
3. Mitchell, H. K., and Houlahan, M. B. *Amer. J. Bot.*, 1946, **33**, 31.

The Chemical Nature and Origin of *Phaseolus* Virus 2 Crystalline Inclusions

Saul Rich[1]

Department of Botany, Oregon State College

Isometric, crystalline inclusions were described by McWhorter (*3*) as occurring in plants infected with *Phaseolus* virus 2. In the present study, qualitative chemical tests were performed on epidermal peelings from broad bean (*Vicia faba*) plants infected with this virus. The fresh integumentary strips were examined under the microscope to find a field containing well-developed crystalline inclusions. The reagent solutions were allowed to flow under one edge of the cover slip as the original mounting material was withdrawn from the opposite edge with a blotter. Fixed material was also tested in some cases. The observations are summarized in Table 1.

In broad bean, there exists a melanin-producing system which may be initiated by wounding. This is made apparent by the discoloration of wounded tissue, which changes in color from normal green to red, and finally to black. Dark areas appear on detached broad bean leaves when they are gradually killed by soaking in physiological saline solution for 24 hrs or longer. The only microscopically visible cytological change in affected epidermal cells was the dark pigmentation of the nuclei. Mosaic-diseased broad bean leaves subjected to this treatment showed the discoloration not only in the nuclei, but also in the crystalline inclusions. The nuclei and inclusions appeared as if treated with hematoxylin. These results suggest the presence of tyrosine in both the nuclei and inclusions, since melanin is presumed to be the end-product of a tyrosine-tyrosinase system (*1*).

The solubility of the crystalline inclusions in both acid and alkali indicates an amphoteric substance. Naturally-occurring amphoteric compounds which are insoluble in fat solvents are limited largely to proteins. This fact, combined with the results obtained with picric acid, the biuret test, Millon's reagent, and the observation of melanin production, shows that the isometric crystalline inclusions of *Phaseolus* virus 2 are proteinaceous.

The crystalline inclusions are found within the nucleolus and cytoplasm only. The primary production of the inclusions within the nucleoli suggests that the crystals are either partly or entirely composed of nucleolar material. The presence of the crystals within the cytoplasm would argue against this theory, were it not for the work of Lenoir (*2*), who reported the secretion of nucleolar fragments from the dividing nucleus into the cytoplasm. It seems reasonable to conclude that the isometric crystalline inclusions of *Phaseolus* virus 2 may be the insoluble end-product of the interaction of virus material and nucleolar material. This theory is further supported by the lack of visible crystals in infected *Melilotus alba*. In this plant the nucleoli are extremely small. The small amount of one of the interacting substances (nucleolar material) would, in this case, restrict the development of the end-product (crystalline inclusions).

TABLE 1

Summary of Crystalline Inclusion Reactions

Chemical	Effect
Nitric acid (conc.)	Crystalline inclusions dissolved
Sodium hydroxide (10%)	" " "
Picric acid (sat. aq.)	Nuclei and crystalline inclusions stained light yellow
Biuret test	Inclusions positive for polypeptide linkage
Millon test	Inclusions positive for phenolic group (tyrosine?)
Formaldehyde (5%)	Slight yellowing of inclusions*
Water (100° C)	No visible effect
Alcohol (95%)	No visible effect; tested on fixed material
Tertiary butyl alcohol	No visible effect; tested on fixed material
Xylol	No visible effect; tested on fixed material
Dioxan	No visible effect; tested on fixed material
Ether (10%)	No visible effect; tested on fixed material
Feulgen's reagent	Crystalline inclusions remained unstained; nuclear chromatin stained red
Acetocarmine (in 45% HAc)	Crystalline inclusions dissolved; nuclear chromatin stained red
Iodine green (10%)	Crystalline inclusions stained dull pink; nuclei stained green†

* McWhorter (*4*) found that inclusions and nuclei fixed in 5% formalin would not stain with trypan blue without previous peptonization in 10% citric acid.

† Purdy (*5*), using iodine green to stain tobacco infected with tobacco mosaic, found the amorphous inclusions stained dull pink, while the nuclei stained green.

References

1. Gortner, R. A. *J. biol. Chem.*, 1911, **10**, 89–94.
2. Lenoir, M. *C. R. Acad. Sci., Paris*, 1925, **180**, 160–163.
3. McWhorter, F. P. *Phytopathology*, 1941, **31**, 760–761.
4. McWhorter, F. P. *Stain Technology*, 1941, **16**, 143–149.
5. Purdy, H. A. *Amer. J. Bot.*, 1928, **15**, 94–99.

[1] Now with the Department of Plant Pathology, Connecticut Agricultural Experiment Station, New Haven, Connecticut.

Effect of Cholinesterase-containing Globulin Fraction of Human Plasma in Macrocytic Anemia

ROBERT D. BARNARD and JOHN W. MENTHA[1]

Terrace Heights Hospital, Hollis, Long Island

Several patients with gastric carcinoma who received multiple whole blood transfusions preparatory to laparotomy were found, on the advent of the latter, to have such extensive metastases that resection was waived. Nevertheless, presumably because of the multiple transfusions, there was a period of increased strength, abatement of pallor, and remission of macrocytic anemia. The previously low blood cholinesterase (ChE_b) established itself at a higher level during this period.

In each patient there was a small transitory rise in blood cholinesterase (confined to the plasma phase and of an extent calculable from the plasma volume and the administered esterase unitage) which subsided before the advent of a more marked secondary rise confined exclusively to the erythrocyte phase (ChE_e) occurring in the first and third patients, and which was of a much greater extent than could be accounted for on the basis of the administered unitage. On subsidence of the secondary rise in the first and third patients, there was a fall to normal in the previously elevated icteric index and a reticulocytosis which, while not nearly as marked as that usually obtained by liver extract therapy, appeared to be of a significant degree.

It has been concluded from this and related studies that the height of the blood cholinesterase, and particularly the erythrocyte cholinesterase, level is the determinant (rather than just the accidental concomitant) of remission in macrocytic anemia, and that Davis's (*3*) hypothesis that macrocytic anemia is the result of a cholinergic "brake" on erythropoiesis is correct in its general implications. Davis considers the estrapenia as allowing acetylcholine to act as a marrow vasodilator; we regard the dynamics of this cholinergic "brake" as that of an atopic reaction on the part of the hemopoietic marrow in which the latter participates as the shock organ (*2*).

The only patient with macrocytic anemia complicating acute malignant leucoblastosis (acute leucemia) to whom we have administered the IV-6 plasma fraction was a child with malignant lymphoblastosis who evinced some transient clinical improvement but who did not respond to the administration by a rise in erythrocyte cholinesterase or by reticulocytosis. Should this single observation be generally confirmed, it may legitimatize the hypothesis that the gravity of the malignant estrapenic

TABLE 1

EFFECT OF IV-6 PLASMA FRACTION ON THE BLOOD PICTURE IN MACROCYTIC ANEMIA

Patient	Date	IV-6 administered (gms)	RBC (million)	Hematocrit (%)	Hb*	Icterus index	ChE_b	ChE_e	ChE_e†	Reticulocytes (%)
Go	9–22					16	4.61			1.0
	9–23	10 ‡	3.13	30	67	18	4.45	2.53	8.84	
	9–23½	20 ‡	3.20	31		16	5.15	3.27	9.24	1.3
	9–24		2.82	29		18	6.10	4.57	8.42	
	9–25		3.09	29		16	9.33	2.80	24.32	1.1
	9–26		3.20	29		10	6.85	2.44	16.98	2.9
	9–27		3.55	31	63	4	5.60	3.02	11.51	3.9
Ra	10–20		2.40	25	55	12				0.6
	10–22	20	2.29	23	52	10		1.92	6.47§	1.1
	10–23		2.33			12		3.13	6.81§	0.8
	10–24		2.27	20		8		1.86	14.64§	1.0
	10–25					10		1.77	9.02§	2.3
	10–26		2.81	25	52	6				6.3
	10–27									4.2

* Hemoglobin concentrations expressed in decimillimols of iron/liter of blood.

† Erythrocyte ChE calculated from ChE_b, ChE_s, and hematocrit.

‡ Intravenous infusion of 4% solution in physiologic saline over an 18-hr period. Infusion interrupted after administration of 10 gms for blood studies.

§ Erythrocyte ChE determined by direct measurement.

To determine directly the role of the cholinesterase content of transfusions in the effect produced in macrocytic anemia, three patients with this type of anemia have been given infusions of IV-6 human plasma fraction. This material contains approximately 500 Alles and Hawes (*1*) units of serum cholinesterase (ChE_s)/gm. A patient with macrocytic anemia complicating ametastatic right colon adenocarcinoma received the equivalent of 15,000 ChE_s units intravenously in a single administration; another patient with rectosigmoid carcinoma with hepatic metastases received 7,000 units; while the third patient, a case of Addisonian anemia in relapse, received 10,000 units. All administrations were uneventful.

[1] The writers are indebted to A. J. Aptaker, H. A. Goldberger, M. Newberg, A. N. Saperstein, and J. M. Seibel, of this hospital, for placing clinical material at their disposal and to the Cutter Laboratories, Berkeley, California, for furnishing the plasma fractions after thorough safety and sterility tests.

blood dyscrasias is conditioned by the degree of loss of ability on the part of the erythropoietic tissues to elaborate cholinesterase. Though other cholinergics besides acetylcholine are undoubtedly involved in the production of cholinergic episodes and the maintenance of cholinergic states in the human, the concomitance of blood cholinesterase level depression with morbidity degree in these dyscrasias may indicate a rational approach to control through substitutive enzyme therapy. Such therapy appears to have been successful in an estrapenic condition, experimental surgical shock in dogs (*5*).

The presence in human plasma (which has not had its cholinesterase activity vitiated) of a factor which permits maturation of leucemic myeloblasts (*2*, *6*) and of a factor (diminished in the estrapenic plasma of relapsing Addisonian anemia) which causes reticulocyte "ripening" (*4*) would appear to warrant the attempt at isolation and the therapeutic trial of these fractions.

References

1. ALLES, G. A., and HAWES, R. C. *J. biol. Chem.*, 1940, **133**, 375.
2. BARNARD, R. D. *Med. Rec.*, 1947, **160**, 610.
3. DAVIS, J. E. *Science*, 1946, **104**, 605.
4. JORGENSEN, S., and PLUM, C. M. *Ugesk. Laeger*, 1943, **31**, 787.
5. SCHACHTER, R. J. *Amer. J. Physiol.*, 1945, **143**, 552.
6. SCHWIND, J. L. *Amer. J. med. Sci.*, 1947, **218**, 170.

Sulfaquinoxaline in the Control of *Eimeria tenella* and *Eimeria necatrix* in Chickens on a Commercial Broiler Farm[1]

L. C. GRUMBLES, J. P. DELAPLANE, and T. C. HIGGINS

Rhode Island State College, Kingston

Delaplane, Batchelder, and Higgins (*1*) first reported the use of sulfaquinoxaline in the prevention of *Eimeria tenella* infection in chickens under laboratory and field conditions. Grumbles, *et al.* (*2*) continued these studies and made more extensive observations on sulfaquinoxaline in preventing and treating both cecal and intestinal coccidiosis (*E. tenella* and *E. necatrix*) under field and laboratory conditions.

Sulfaquinoxaline was fed at the rate of 0.05% to chickens subjected to severe exposure of coccidia on a commercial broiler farm. The drug was given 2 days out of 5 (2–3 schedule), 1 day out of 4 (1–3 schedule), 1 day out of 5 (1–4 schedule), 2 days out of 6 (2–4 schedule), 4 days out of 8 (4–4 schedule), and at the rate of 0.0125% fed continuously.

Results of studies on 43,309 sulfaquinoxaline-treated birds and 3,085 untreated controls are shown in Table 1. The deaths from coccidiosis among the medicated birds were 1.75, 2.17, 1.80, 0.86, 1.13, and 1.20% as compared to 17.43% in the controls. The birds which died from coccidiosis showing *E. necatrix* infection were 0.63, 0.26, 0.28, 0, 0.13, and 0.12%, respectively, as compared to 7.45% in the controls.

Thus, sulfaquinoxaline used at the rate of 0.05% intermittently and 0.0125% continuously in the feed is effective in the control of *E. tenella* and *E. necatrix* infection in chickens. No symptoms of toxicity were observed in the birds after the use of the drug at the levels cited.

TABLE 1

Schedule	No. of birds	Coccidiosis mortality (%)			
		Cecal	*E. necatrix*	Both*	Total
Control pens	3,085	9.98	3.53	3.92	17.43
"2–3" .05% S.Q.†	17,699	1.12	0.51	0.12	1.75
"1–3" .05% S.Q.	7,348	1.91	0.18	0.08	2.17
"1–4" .05% S.Q.	5,459	1.52	0.02	0.26	1.80
"2–4" .05% S.Q.	1,043	.86	0	0	0.86
"4–4" .05% S.Q.	1,575	1.00	.13	0	1.13
0.0125% continuous	10,181	1.08	0.1	0.02	1.20

* Both *E. tenella* and *E. necatrix* infections.
† Sulfaquinoxaline.

References

1. DELAPLANE, J. P., BATCHELDER, R. M., and HIGGINS, T. C. *N. Amer. Vet.*, 1947, **28**, 19–24.
2. GRUMBLES, L. C., DELAPLANE, J. P., and HIGGINS, T. C. (To be published.)

[1] This study was made possible by a grant from Merck & Company, Inc., Rahway, New Jersey. Contribution #709 of the Rhode Island Agricultural Experiment Station.

Weed Control in the Tropics

A. S. CRAFTS[1]

Department of Agronomy, Agricultural Experiment Station, Rio Piedras, Puerto Rico

The use of cheap labor for hoeing weeds is traditional in the tropics. Only recently have chemicals been given serious consideration. The low cost and great effectiveness of the 2,4-D herbicides have created new opportunities for improvement of cultural methods and conservation of labor. Van Overbeek and Vélez (*4*) and White and Villafañe (*6*) have pointed out the unique value of 2,4-D as a selective weed killer in cane and other tropical crops.

The selective nature of 2,4-D is at once a virtue and a fault. Being relatively nontoxic to cane and coffee (*4*), this herbicide can be used with little or no injury in these crops. On the other hand, being nontoxic to grasses, one of the large and important groups of weeds is im-

[1] On leave from the University of California College of Agriculture, Davis, California.

A. Emanuelli, assistant agronomist with the Puerto Rico Agricultural Experiment Station, has cooperated actively in the conduct of this research.

mune to its action. Grasses are known to exist in cane, coffee, pineapples, and other important crops of Puerto Rico and Hawaii. They undoubtedly thrive in many other regions of the tropics. Species of such genera as *Cenchrus, Cynodon, Echinochloa, Eleusine, Panicum, Paspalum, Setaria, Trichachne,* and others are common in and around the cane fields of Puerto Rico. Not only do they grow in the cane rows, where hand-hoeing is required to remove them, but they abound along roads, drainage and irrigation ditches, fence lines, and railway ballast; in fact, they make up an important part of the plant population of every nontilled area.

Recognizing the ineffectiveness of 2,4-D against grasses, Van Overbeek and Vélez (*5*) recommended that they be controlled by mechanical cultivation; 2,4-D, therefore, was only a supplementary treatment to correct the shortcomings of mechanical methods. It has proved particularly useful in the humid regions, where *Commelina* (day lily) species are very difficult to control by mechanical means.

In view of the experiences of many growers in Puerto Rico, the early statements of Van Overbeek and Vélez (*5*), *i.e.* "completely effective against nutgrass," "a concentration between .05 and .075 per cent is sufficient to exterminate commelina completely," and ".3 per cent gave complete eradication (of nutgrass)," seem somewhat optimistic. Although under the ideal conditions of experimental spraying such results could be obtained, actually neither of these weeds is responding so favorably. Many factors are responsible such as the unpredictable tropical rains, inefficiency of the workers, spreading by tillage and irrigation water, etc. If chemical weed control is satisfactorily to supplement hoe labor in controlling tropical weeds, a systematic program of periodic treatments will be required; and if it is completely to replace mechanical methods, a contact spray capable of controlling grasses is needed.

Recent studies based on several years of research (*1, 2, 3*) indicate that the following formula will provide a satisfactory oil emulsion contact spray, low in cost, and convenient to handle: medium gravity highly aromatic oil, 30 lbs; pentachlorophenol, 2 lbs; Oronite wetting agent, 2 lbs; and water, 95 gals.

The oil used in the experimental work was a bottoms or residue left after the recovery of gasoline from the fraction produced by catalytic cracking of petroleum. Much of this oil is being produced, but it is employed as furnace fuel for want of a better use. Two weed-killing oils, Shell #20 and Standard (of California) #2 are of this type. In making up the spray emulsion, the pentachlorophenol and Oronite are dissolved in the oil. Gentle heating speeds this process. When this concentrate is ready, it is emulsified in the water, using violent agitation. After it is mixed, gentle agitation will keep it stable.

This spray emulsion will kill all green vegetation, but it will not kill cane, coffee, pineapple, or banana plants if used only around the bases and kept off the leaves. It can be used as a pre-emergence spray before planting and as a general contact spray against all weeds as soon as the shoots are a foot or more in height. It should be kept off the young leaves of cane and out of the crowns of pineapple plants.

Even this spray, though toxic to all green vegetation, will not control all weeds. In fact, the above formula is designed to kill young grass seedlings in cane with a minimum of damage to the latter.[2] At this concentration, bejucos (*Ipomoea* sp.) are killed only to the ground line, from whence they resprout. *Commelina* and coqui (nutgrass) are only slightly injured, and the injury is slow in developing. Herein lies the key to a very significant discovery.

Ordinarily in the use of 2,4-D, toxic materials as solvents or coupling agents are avoided, the reason being that immediate injury to the leaves will prevent satisfactory translocation of the herbicide to the stems and roots. This is basically sound, but it does not apply to the combination of 2,4-D with the contact emulsion described above when used in Puerto Rico, because *Commelina,* bejucos, and coqui are not rapidly injured and are extremely sensitive to 2,4-D. Therefore, it has been found that 1 lb of 2,4-D or its equivalent of an ester can be added to the concentrate consisting of the three first items of the formula given above, and that the resulting emulsion spray will kill grasses, *Commelina*, coqui, bejucos, morivivi (*Mimosa pudica*) and many other weeds. In other words, it combines the virtues of a general contact herbicide with those of 2,4-D to give a spray that kills most of the weeds of tropical crops.

One additional problem is acute in the tropics—the control of coarse, vigorous grasses such as malojillo (*Panicum purpurascens* Raddi) and zorra (*Trichachne insularis* (L.) Nees.) in drainage and irrigation ditches, in fences, along roadsides, and in every nontilled area.

If 2 lbs of pentachlorophenol are dissolved in 1 gal of the highly aromatic oil described, and this is mixed in 100 gals of diesel fuel, waste crankcase oil, or any other oil of light enough viscosity to flow through the nozzle, this fortified oil will be found to give excellent results, especially if it is used in sufficient quantity to cover the grass thoroughly and soak down into the crowns. Where the highly aromatic oil is available in quantity it may be used directly without fortification.

References

1. Crafts, A. S. *Science,* 1945, **101**, 417–418.
2. Crafts, A. S. *Calif. agric. Ext. Serv. Circ. 137,* 1947.
3. Crafts, A. S., and Reiber, H. G. *Hilgardia,* 1945, **16**, 487–500.
4. Van Overbeek, J., and Vélez, Ismael. *Science,* 1946, **106**, 472–473.
5. Van Overbeek, J., and Vélez, Ismael. *Amer. Soc. hort. Sci. Proc.,* 1946, **47**, 434–438.
6. White, David G., and Villafañe, Aida G. *Agric. in the Americas,* 1946, **6**, 126–128.

[2] This formula may be modified to meet almost any condition. The pentachlorophenol concentration may be increased to 3 lbs for use in cane over 2½′ in height. For roadside weeds 4 lbs or more may be used. For coarse, mature grasses the oil concentration may be increased to 45 lbs or more, or the killing power may be increased by simply emulsifying the stock solution in less than 95 gals of water.

The Male Frog, *Rana pipiens,* as a New Test Animal for Early Pregnancy

P. B. WILTBERGER
Columbus, Ohio

D. F. MILLER
Department of Zoology and Entomology, The Ohio State University

In a series of tests run during recent months we have found the male frog, *Rana pipiens,* to have high diagnostic value as a test animal for early pregnancy. These animals are easily obtainable in the United States, are not killed for the test, and may be used over again. The test is of relatively little value in the last months of pregnancy, but after the first trimester any test for pregnancy is, after all, principally of academic interest.

Ever since Ascheim and Zondek first proved that the gonad-stimulating substances in pregnancy urine were capable of stimulating the ovaries of immature rodents, subsequent modifications of their test have been made on female animals. It seems that the male gonads had been quite forgotten until Mainini (*1*) showed in March of 1947 that these substances would also cause the release of spermatozoa in the South American toad, *Bufo arenarum* Hensel. Siegler and Fein (*2*) have presented a graph showing the concentration of the chorionic gonadotropic hormones in the blood and urine of pregnant women. This graph indicates that the concentration begins about the 15th day, rises rapidly till the 30th day, and drops rapidly till the 90th day. It remains at a low level throughout the remainder of the pregnancy and drops to zero after the delivery of the complete placenta.

In our pregnancy tests with male frogs we have found that our results tend to correspond to this graph. Urines tested from women in the last trimester gave us nearly 50% false negative results, whereas those urine specimens from the *first trimester* so far have given entirely positive results. There have been no false negatives. In our series we have used well over 200 test animals with the urines of pregnant women, nonpregnant women, and men. Check animals were untreated frogs and frogs injected with Ringer's solution (cold). No check animal has ever produced spermatozoa. The possibility of seasonal variation is still unknown.

The technic of the test is simple. A first morning (overnight) specimen of urine is obtained and 5 cc carefully injected subcutaneously into the dorsal or lateral lymph sacs of the frog. Two or more frogs are used, as there may be a difference in sensitivity to the test. Each frog is placed in a separate, clean, dry glass jar with a perforated lid and set aside for 2–4 hrs at room temperature. At the end of this time any urine that has been voided by the frogs is examined microscopically. If spermatozoa are not present, the urine is carefully drained from the jar without disturbing the frog. The frog is then seized in the hand while still in the jar. This pressure usually induces another urination. The new specimen of urine is then examined for spermatozoa. The frog's sperms are easily identifiable. When spermatozoa are present, the test is positive; when they are not present, the test is negative. The fact that there are no intergrades eliminates all subjective interpretations. The test animals are not killed and may be used for another test after 4 or 5 days.

A more detailed summation of our work will be published later.

References

1. MAININI, GALLI. *Sem. med., B. Aires,* 1947, **54**, 337.
2. SIEGLER, S. L., and FEIN, M. J. *Amer. J. Obstet. Gynec.,* 1939, **38**, 1021.

Chromosome Breakage in Plants Induced by Radioactive Phosphorus (P^{32})

T. J. ARNASON, ELAINE CUMMING, and J. W. T. SPINKS[1]

University of Saskatchewan, Saskatoon

That X-rays, radium, and certain other rays emitted by a source external to living cells induce chromosome breaks and rearrangements is well established (*1*). Consequently, radioactive elements emitting beta or gamma rays within living cells may be expected to produce similar results. When the source of radiation is external, it is usually most convenient to give the radiation treatment in one or a few doses of rather short duration. With radioactive elements introduced into the tissues, low dosage per unit of time may be continued over a long period. The fact that some radioactive elements may be incorporated in the chromosomes may also have effects of special interest. The recoiling nucleus will almost certainly have enough energy to break any chemical bond (*2*). Comparable initial dosages of different radioactive elements may show somewhat different effects, since there may be differential localization of the active element, the rays may differ in hardness, and the rates of decay may be very different.

Preliminary experiments on mutation induction by radioactive phosphorus (P^{32}) have been carried out, using the following plants for test organisms: *Triticum aestivum* L., variety *Thatcher* (n = 21), *T. durum* Desf., variety *Pelissier* (n = 14), *T. monococcum* L. (n = 7), and *Hordeum distichon* L., variety *Hannchen* (n = 7).

In the most complete series of tests undertaken, the radioactive phosphorus was made available to the germinating seeds and young seedlings. Seeds to be treated were divided into two equal lots supplied, respectively, with .18 and .018 microcurie of P^{32} for each seed (P^{32} in the form of Na_2HPO_4). Forty-eight seeds of each species were treated; 6 untreated plants of each species were used as controls. The seedlings were transferred from the test tubes to 1-gal crocks containing untreated soil 13 days after seed germination began. At this time it was found that $90 \pm 4\%$ of the activity in the original solution had entered the plants.

[1] It is a pleasure to acknowledge assistance from the National Research Council of Canada and from Dean B. Cowie, of the Carnegie Institution of Washington.

Pollen mother cells of treated plants and controls were prepared by the usual acetocarmine smear technique, the preparations being made permanent by mounting in diaphane. Many clear irregularities were observed, these being most frequent in the tetraploid durum wheat and the hexaploid aestivum (vulgare) wheat. Both concentrations of activity induced rearrangements. No clear-cut aberration was detected in barley, and only one of the heads of Einkorn wheat gave evidence of chromosome breakage and rearrangement.

In 22 anthers configurations characteristic of particular rearrangements were repeated in several or many cells; anthers from several spikelets of one head all had the same chromosome rearrangment. The chromosome breakage must have occurred some divisions before formation of pollen mother cells and spikelets, respectively.

TABLE 1

NUMBER OF POLLEN MOTHER CELLS HAVING VISIBLE CHROMOSOME ABERRATIONS FOLLOWING SEED AND SEEDLING ABSORPTION OF RADIOACTIVE PHOSPHORUS

Species	Micro-curies of P^{32}	Total no. of cells examined	No. of visibly aberrant cells	No. of different chromo-some rearrange-ments*
Triticum monococcum	.018	107	26	1
	.18	112	0	0
	0	65	0	0
Triticum durum	.018	90	8	1
	.18	172	30	4
	0	54	0	0
Triticum aestivum	.018	48	6	1
	.18	216	21	4
	0	73	0	0
Hordeum distichon	.018	72	0	0
	.18	115	0	0
	0	164	0	0

* Aberrant cells occurring singly among normal cells are not recorded in this table.

Aberrations observed in division I included chromosome fragments, chains of three or four chromosomes, rings of four, and unequal pairs. The occurrence of inversion was indicated by anaphase bridges and fragments. In division II, anaphase and telophase bridges and fragments were sometimes encountered. A summary of the treatments given and the principal observations made is provided in Table 1. Aberrations are recorded in the table only if they appeared in more than one cell of an anther. Cells with fragments or configurations indicating translocation, inversion, or deficiency also occurred singly among normal cells, however.

Of 19 anthers examined from Thatcher wheat plants grown in soil to which radioactive phosphorus had been added in the form of a phosphate fertilizer (*3*), three had aberrations involving blocks or clusters of cells. A sunflower head injected with 1.8 microcuries of P^{32} yielded pollen mother cells 11 days later. Of these three (out of 45 examined) had anaphase-I bridges.

More complete reports of this work will be published elsewhere.

References

1. LEA, D. E. *Actions of radiations on living cells.* Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1946.
2. LIBBY, W. F. *J. Amer. chem. Soc.*, 1947, **69**, 2523.
3. SPINKS, J. W. T., and BARBER, S. A. *Sci. Agric.*, 1947, **27**, 145–156.

The Electric Charge of Red Blood Cells in Malaria[1]

W. B. REDMOND

Department of Biology, Emory University, Georgia

In a parasitic infection such as malaria, in which the relationship of the red blood cells and the parasites is so vitally important, the electrokinetic charges on the surfaces of the red cells and parasites may be of considerable importance in such aspects of the infection as the immunity, the effect of drugs, and the specificity of infections. Since it has been shown that such processes as agglutination (*7*), phagocytosis (*6*), and inflammation (*1*) are correlated with changes of the surface charge, it seems very likely that the charge on the cells may be involved in the penetration of the red cell by a malaria parasite. The reduction of the cell charge by specific agglutinins and opsonins is not without parallel in an infection of malaria. Though these antibodies are in most cases very difficult or impossible of demonstration in malaria, the importance of phagocytosis is probably not greater in any other infection. Consequently, the demonstration by Brown (*3*) that the charge on the red cells in malaria is reduced needs further investigation.

The initial work on electrophoresis in malaria carried out by Brown (*3*, *4*) and by Findlay and Brown (*5*) demonstrated that the electrokinetic charge on the red cell is reduced during the patent period of the infection, and the condition persisted for days after the parasites disappeared from the blood. Brown (*4*) observed no difference in the migration rates of infected and non-infected cells of infected canaries. Findlay and Brown found a distinct correlation between the 'cataphoretic velocity' of the red cells and the size of the spleen, and the number of splenic macrophages containing parasites. As the migration rate of the red cells decreased, the number of macrophages and the size of the spleen increased. Brown's experiments (*3*) indicate that the factor or factors responsible for the reduction in the cell charge are to be found in the serum (plasma). He found that cells of an immune bird suspended in the serum of a normal bird migrated at the same rate as normal cells, and that cells from a normal bird suspended in immune serum migrated at the same reduced rate as cells from an immune bird.

[1] This work was aided by a grant from the National Institute of Health, U. S. Public Health Service.

Using the Abramson (*2*) electrophoresis cell, determinations have been made on the red blood cells of normal pigeons and pigeons infected with *Plasmodium relictum*. The cells were suspended in a buffer-glucose solution at pH 7.5, and the technique used was that developed by Abramson (*2*). The mean electrophoretic mobility of red cells of normal pigeons has been found to be 1.41 μ/sec/v/cm² in the above medium. In infected birds the migration rate of the red cells gradually decreases as the infection increases, and, following the peak in parasite number and the reduction of the parasite count, the rate decreases rapidly. At the time at which the parasite count has been reduced to zero, the mobility of the red cells is found to range between 1.15 and 1.25 μ/sec. On the first or second day following the termination of the infection, the rate increases very slightly and fluctuates about this new value for several weeks. In Fig. 1 is shown the daily parasite count and the electrophoretic mobility of the red cells of one of the infected birds, together with the mobility of the cells of a normal pigeon. In a few cases, the rates of the cells of birds with latent infections have been found to be greater than the lowest rates for normal birds, but in most cases they range well below the 'normal' values. Determinations were made on the cells of one bird 329 days following infection. The average mobility of the cells of this bird was 1.24 μ/sec.

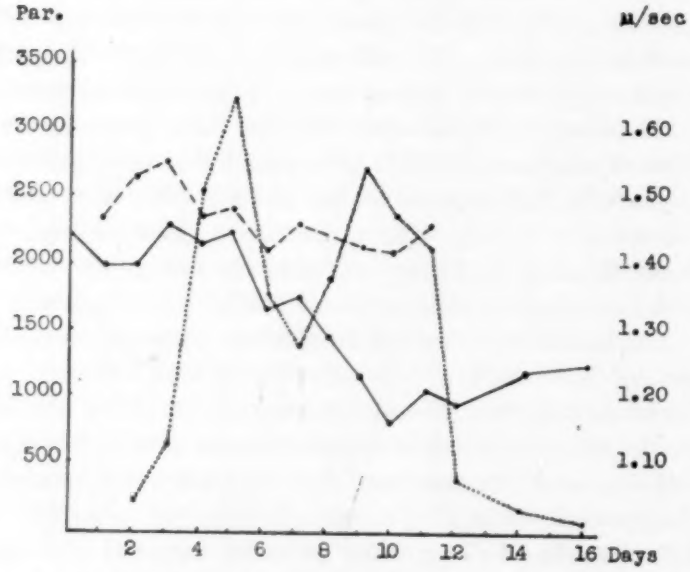


FIG. 1. Electrophoretic mobility of red blood cells from normal and infected birds.
-- Normal bird. ——— Infected bird. ..... Parasites/10,000 R.B.C.

Brown found that cells containing parasites migrated at the same rate as noninfected cells. The pigeon erythrocytes containing parasites are observed to migrate at a much slower rate than uninfected cells from the same bird. The difference in the rates of the two cells is very noticeable. The uninfected cells can be observed to approach and pass those containing parasites. On reversing the current, the uninfected cells again pass the infected cells. The corresponding rates for infected and uninfected cells are shown in Table 1. In general, the infected cells are much slower during the period of decline in parasite numbers than during the first few days when the parasites are increasing in number. Occasionally, parasitized cells have been observed to migrate at the same rate as uninfected cells. These cells almost invariably contain small parasites. Other infected cells in the same suspension which contained larger and more mature parasites were seen to migrate at a much slower rate. However, not all small parasites were observed to migrate with the uninfected cells.

TABLE 1

ELECTROPHORETIC MOBILITIES OF RED BLOOD CELLS CONTAINING PARASITES AND OF UNINFECTED CELLS FROM INFECTED BIRDS

Infected (μ/sec)	Uninfected (μ/sec)
1.08	1.31
0.88	1.35
0.80	1.21
1.08	1.26
0.82	1.18
0.77	1.22
1.11	1.20
1.04	1.21
0.94	1.30
1.09	1.32
0.85	1.29
1.04	1.27
1.05	1.35
0.89	1.09
0.86	1.19
1.01	1.21
0.74	1.13
1.04	1.29
0.80	1.22
1.09	1.26

These results show that in pigeons infected with *P. relictum* the electrokinetic charge of the red blood cells is reduced. The demonstration that the charge on the cells containing parasites is much less than that on uninfected cells of the same bird indicates that this condition may be a factor in reduction of the parasite number. The fact that the reduced charge is found to persist during the latent condition may still further indicate this possibility. The permeability of the red cell membrane may be altered by the change in the surface charge. This would undoubtedly affect the respiration and metabolism of the parasite. Further investigations are being made into this aspect of the problem with respect to the method of action of antimalarial drugs.

References

1. ABRAMSON, H. A. *Cold Spr. Harb. Sympos. quant. Biol.*, **1933, 1,** 92–106.
2. ABRAMSON, H. A. *Electrokinetic phenomena and their application to biology and medicine.* New York: Chemical Catalogue, Reinhold, 1934.
3. BROWN, H. C. *Brit. J. exp. Path.*, **1933, 14,** 413–421.
4. BROWN, H. C. *Trans. roy. Soc. trop. Med. Hyg.*, 1933, **26,** 515–522.
5. FINDLAY, G. M., and BROWN, H. C. *Brit. J. exp. Path.*, **1934, 15,** 148–153.
6. MUDD, STUART. *Cold Spr. Harb. Symp. quant. Biol.*, 1933, **1,** 77–91.
7. MUDD, STUART, LUCKE, B., MCCUTCHEON, M., and STRUMIA, M. *J. exp. Med.*, **1930, 52,** 313–329.

IN THE LABORATORY

The Ecchymosis Test for Capillary Hemorrhagic Diathesis[1]

ALFRED LEWIN COPLEY

Laboratory of Cellular Physiology, Department of Biology, New York University

A large number of clinical tests have been devised for estimating the degree of capillary fragility. These tests are based on petechial counts following applications of positive or negative pressure and indicate the strain required to rupture the blood capillaries of the skin. These methods do not always test a hemorrhagic diathesis associated with increased capillary fragility. Moreover, clinical conditions without a hemorrhagic tendency are known which exhibit increased capillary fragility (*3*).

The ecchymosis test measures the strength and hemorrhagic diathesis of skin capillaries expressed by the amount of pressure necessary for the production of ecchymosis and the degree of ecchymotic involvement of the tested area. It is made in full daylight or at equivalent artificial light. There is no need for a magnifying lens, though an electrically illuminated 5-power magnifier has been found to be a convenient aid.

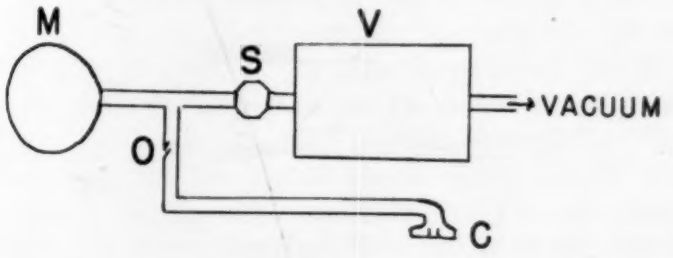


FIG. 1

A vacuum pump which permits high negative pressures is attached to a vacuum chamber. The vacuum in the system is subjected to as rapidly increasing pressure as possible. A special device, schematically diagrammed in Fig. 1, permits these pressures to be increased or reduced within a few seconds. It also secures the maintenance of a desired pressure for any length of time. This is accomplished by turning the screw of a needle valve (S), attached to the vacuum chamber (V), until the manometer (M) shows that the desired negative pressure has been reached. A T-tube connects a suction cup (C) with the manometer and the vacuum chamber. The T-tube has a minute opening (O), permitting rapid release of the pressure. (Such an opening can also be secured by piercing a gauge-20 needle through the wall of the connective rubber tubing.)[2]

[1] Aided in part by a grant from the American Medical Association.

[2] A portable, light-weight apparatus termed "purpurameter" has been devised and can be obtained from the C. M. Sorensen Company, New York City.

The test is performed as follows: A suction cup of 4.5-mm internal diameter is placed on the skin in the internal brachial region, 3–9 cm below the apex of the axilla, and negative pressures in increments of 100, beginning with −100 to −600 each, are applied for 2 min on different parts of the skin in this region. The degree of ecchymosis is read immediately following the sudden release of the pressure. Large petechiae may constitute a beginning ecchymotic lesion. They may consist originally of several small petechiae which had become confluent, or they may mark extravasation from one single injured capillary. Therefore, such large petechiae were designated as ±, or doubtful ecchymosis. Three degrees of ecchymosis are differentiated: 1+, or feeble, consisting of large ecchymotic plaques; 2+, or moderate; and 3+, or strong ecchymosis. The latter covers almost the entire area. The area becomes hyperemic as a result of the applied pressure. If there is any doubt as to whether an undeniably ecchymotic spot or area is present, plain glass or Lucite should be pressed down on it. The hyperemic area will blanch, whereas the visibility of the hemorrhagic manifestation will remain unaltered or even increase.

The test permitted the detection of a capillary hemorrhagic diathesis in a group of subjects with a history and manifestations of capillary bleeding. It has also been studied in a control group of 51 subjects—students and investigators at the Marine Biological Laboratory (*2*). In healthy subjects, pressures up to −500 mm Hg, and in other instances up to −600 mm Hg, were found to produce petechiae in varying numbers, but no ecchymotic lesions. In cases with capillary hemorrhagic diathesis, pressures up to −300 mm Hg produced ecchymosis. The ecchymosis test proved useful in evaluating the effect of rutin therapy in 3 patients with vascular purpura. A significant reduction in the production and degree of ecchymosis was observed in these cases after rutin therapy.

The selection of the internal brachial region for making petechial counts, which was made by trial and error, resulted in the development of the ecchymosis test. Cosmetic considerations make this site also preferable in female subjects. Contiguous cutaneous regions are not suitable because of the increased thickness of the epidermis. Copley and Kozam (*2*) found that the internal brachial region tended to yield higher petechial counts, and, in some cases, an increased ecchymotic production when compared with observations of studies on the supraclavicular and infraclavicular regions. A suction cup of 4.5-mm internal diameter was found to be more suitable than the larger suction cups which are generally used in petechial count methods. This cup covers an area of 15.7 mm^2 and thus permits repeated tests in the same region on the same day. Although the test period can be varied, a 2-min period was found adequate.

The mechanism of ecchymotic formation is not understood. There may be qualitative differences between the hemorrhagic manifestations of petechiae and of ecchymosis, the latter possibly being more characteristic for certain conditions. High negative pressures may produce many petechiae without a tendency to form an ecchymosis.

The ecchymosis test is a simple, painless, clinical procedure which permits rapid readings and which may prove to measure more adequately the strength and hemorrhagic diathesis of skin capillaries than the various methods of petechial counts hitherto employed in man. It can be used in different regions of the human body and can also be applied to experimental animals. With it, the local or systemic effect of drugs, chemical agents, and other treatments can be tested.

References

1. COPLEY, A. L. (To be published.)
2. COPLEY, A. L., and KOZAM, G. Unpublished data.
3. PECK, S. M., and COPLEY, A. L. *New Eng. J. Med.*, 1946, **235**, 900.

Method for Making Cartesian Divers

C. LLOYD CLAFF

Laboratory for Surgical Research, Harvard Medical School, Boston, and *Marine Biological Laboratory, Woods Hole, Massachusetts*

The problem of making Cartesian divers is among the first to confront the investigator who becomes interested in Cartesian diver technique (*2, 3*). This heretofore time-consuming and difficult operation can be reduced to a controlled routine procedure by the method to be described. This method differs from those described by Boell, Needham, and Rogers (*1*) and Holter (*2*) in that, instead of being a free-hand operation requiring considerable practice and skill in glass blowing, the various stages in the process are carried out in a jig which keeps the capillary in alignment at all times. Not only do the divers tend to be more nearly uniform and symmetrical but, by slight modification of the technique, it is possible very easily to make flat-bottomed divers (Erlenmeyer type) (*2*) and divers with either thick or thin tails.

Thick-walled Pyrex capillary tubing is selected. This may vary in outside diameter from .030″ to .060″ (0.762–1.524 mm), depending on the size of diver desired. A hot needle-point flame is adjusted on a micro-gas burner[1] using a mixture of gas and compressed air. The jig[2] (Fig. 1A), made of aluminum or brass, is composed of two parts, a stationary part attached to a handle and a removable part. There are two sets of paired holes in the jig, one each for making divers with relatively thick tails and with thin tails. In the first set, the paired set of holes are the same size; in the second, the paired holes differ in size. (The holes in the removable section are all the same size, being made by a very small drill—#77 drill, .018″.) This is done so that the thin rod of the "blank" will not wobble while it is twirled in the jig.

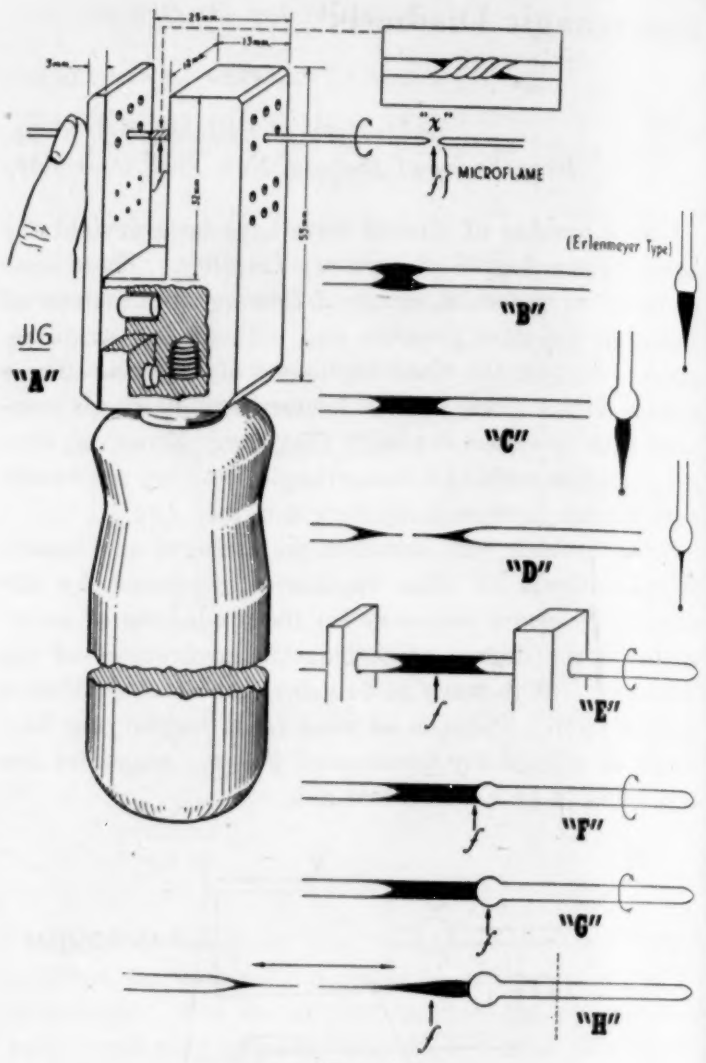


FIG. 1

Suitable drills for making the holes which will accommodate capillaries with outside diameters of .038″–.057″ are as follows: #53, .059″; #54, .055″; #55, .052″; #56, .046″; #57, .043″; #58, .042″; #59, .041″; and #60, .040″. When a capillary of convenient length has been selected it is inserted into the hole in the jig which best accommodates it so that it can be twirled easily, without wobbling. With the capillary inserted in the jig so that about 20 mm protrudes from the left side, the jig is held in the left hand in such a manner that the forefinger of that hand can push lightly against the protruding capillary and, when necessary, keep it from turning, and also in such a manner that the flame melts the glass in the middle of the jig (Fig. 1A). When the capillary is collapsed and the glass is molten over an area of 3–4 mm, the capillary protruding from the left side is held with the forefinger of the left hand, and the glass on the right-hand side of the jig is twisted 3 or 4 complete revolutions. This effectively seals off the lumen of the capillary from the rod and helps eliminate air bubbles. The pressure from the left forefinger is then released,

[1] A suitable micro-gas burner is the Orthodontic Blow Pipe #11, distributed by S. S. White Dental Manufacturing Company, Philadelphia, Pennsylvania.

[2] The jig is available from Carl A. Moeller, 242 Warren Street, Randolph, Massachusetts.

the entire capillary being allowed to spin freely back and forth in the flame. The result will be a solid rod of glass, 3 or 4 mm long, where the flame has collapsed the capillary. This first step must be carried out as outlined to preclude air spaces in the glass rod.

If thick tails and flat-bottomed divers are required, the capillary should be turned to and fro in the flame until the molten glass has assumed a form slightly larger than the original capillary (Fig. 1B).

If medium-thin tails and round-bottomed divers are desired, the glass is pushed to the left of the jig, the solid rod section reheated, and, while being held with the forefinger of the left hand, the capillary is pulled to the right until the desired thickness is obtained. After releasing pressure on the capillary, it is reheated and turned to and fro until the solid rod becomes uniform throughout (Fig. 1C). To complete the "blank," pressure is again applied with the forefinger of the left hand and the capillary sealed approximately 25 mm from the right-hand side of the jig (Fig. 1Ax).

If very thin tails are desired, a "blank" is produced as shown in Fig. 1B. This is removed from the jig before the capillary is sealed at "x." The solid rod portion is then reheated and removed from the flame. Just before the red glow has almost disappeared from the glass, it is pulled apart (Fig. 1D). The result is a thin tail ending in a thin thread of glass. This is broken a few millimeters from the end of the tail. The capillary is sealed off approximately 40 mm from the solid rod portion. The "blank" is again returned to the jig, this time, however, in one of the lower sets of holes so that the thin portion of the tail fits into one of the very small holes. To form the bubble of the diver, the "blank" is twirled to and fro in the jig while the flame is applied to the solid portion of the tail. When this is red hot, the jig is moved slightly to the left. Here one should watch carefully for the cone-shaped junction of the capillary and solid rod to flatten out. If the jig is moved a little more to the left, a bubble will form. The twirling to and fro should be continued until the bubble is the desired size. The "blank" is then withdrawn and twirled until it is cool (Fig. 1E, F, G).

In making divers with thick or medium-thick tails, it is not necessary to remove the "blank" from the jig, inasmuch as all operations are carried out in one set of holes. After the bubble is formed, the "blank" is removed, and, if the tail has not been previously drawn out to a thread of glass, it is done at this time (Fig. 1H). The capillary is cut 8–10 mm from the top of the bubble to form the neck of the diver.

Prior to being weighed and calibrated each diver should be examined microscopically to see that the bottom is not cone-shaped and that there are no air bubbles in the solid tail portion.

Calibration

The total gas volume of each diver is determined by weighing it both empty and filled with mercury (*4*). Having determined what volume is to be used for the bottom drop, NaOH seal, and oil seal, the correct weight of the diver (g) for its particular volume necessary for it to float in the selected medium is found by using the following formula:

$$g + V_O P_O + V_L P_L = V_A + \frac{g}{2.23} \times 1.321$$

$$g - \frac{g}{2.23} \times 1.321 = V_A \times 1.321 - V_O P_O - V_L P_L$$

$$g \left(1 - \frac{1.321}{2.23}\right) = V_A \times 1.321 - V_O P_O - V_L P_L$$

$$g = \frac{V_A \times 1.321 - (V_O P_O + V_L P_L)}{1 - \frac{1.321}{2.23}}$$

where g = weight of diver glass (final), V_O = volume of oil seal, P_O = density of oil (0.8), V_L = volume of aqueous phase (medium + NaOH), P_L = density of aqueous phase (1.0), 1.321 = density of flotation medium, 2.23 = density of Pyrex glass, and V_A = total volume of diver.

The amount of Pyrex glass which has to be added to the tail is the difference between the actual empty weight of the diver and the theoretical correct weight necessary for it to float in a particular medium. Glass from a thin glass thread is added until the diver weighs within 0.1 mg of its correct weight, and then the glass is fused into a ball at the end of the tail.

The formula for the calibration of K, the diver constant for an experimental temperature of 27.8°C, 1.0 mm³ medium, and 1.0 mm³ each of NaOH and oil, respiration in air, is as follows:

$$K_{O_2}^{27.8°C} = \frac{V_{AIR}^* \times \frac{T}{T+t} + (V_{LIQ}^{\text{at } t°C}\, \alpha_{LIQ}) + (V_{OIL}\, \alpha_{OIL}^{\text{at } t°C})}{760 \times 13.54}$$

where V_{AIR}^* = total air volume *minus* (vol. liquid + vol. oil), T = temperature of absolute zero (273°), t = temperature of experimental °C (27.8°), V_{LIQ} = NaOH + medium, α_{LIQ} = solubility of O_2 in medium and NaOH at t° C (assumed .029), V_{OIL} = volume of oil seal, α_{OIL} = solubility of O_2 in oil at t° C (assumed 0.1), and 13.54 = weight of 1 cc of mercury at 25°C. (See International Critical Tables for values of α_{O_2} and α_{CO_2} at different experimental temperatures.)

Numerical values in the above formulas may be substituted for the ones given when such values more accurately reflect the actual conditions of the particular experiment and materials used.

The formula for a flotation medium (*2*) is: 27.2 gm of $NaNO_3$,[3] 13.7 gm of NaCl, and 59.1 gm of H_2O (density = 1.321).

References

1. Boell, E. J., Needham, J., and Rogers, V. *Proc. roy. Soc. Lond.*, 1939, **127**, 322–356.
2. Holter, H. *C. R. Lab. Carlsberg*, 1943, **24**, 399–478.
3. Linderstrom-Lang, K. *C. R. Lab. Carlsberg*, 1943, **24**, 333–398.
4. Peters, John P., and Van Slyke, Donald D. *Quantitative clinical chemistry*. Vol. II: *Methods*. Baltimore: Williams & Wilkins, 1942. P. 5.

[3] The salts should be heated in a 100°-C oven overnight to be sure they are anhydrous before weighing.

Laboratory Preparation and Decontamination of Mustard

A. M. REEVES and S. LOVE

Chemical Corps Technical Command,
Army Chemical Center, Maryland

In the preparation of mustard a hood with a good draft should be used. Dissolve 122.2 gm (1 mole) of Kromfax solvent in 978 gm of 36% hydrochloric acid in a 2-liter round-bottom flask and place under a reflux condenser. Heat this solution between 80° and 90° C for 1 hr. The liquid will become turbid, due to the separation of the mustard. Allow to cool and separate the lower layer by means of a separatory funnel. The mustard thus obtained may be freed from excess HCl by passing a stream of dry air through it. The weight of product should be about 149.5 gm, or 94% of theory, and the melting point about 13° C, which indicates a purity of 96%. Pure mustard has a melting point of 14.5° C.

The crude material can be dried by heating under vacuum at 50 mm, at a bath temperature of 100° C, for 1 hr. Purification can be obtained by distillation in vacuum from a round-bottom flask fitted with an air-bubbler tube and equipped with a short column (7″) packed with glass helices. Useful boiling points of mustard are 81°/5 mm, 93°/10 mm, and 107°/20 mm.[1]

In handling this material, it should be remembered that it acts as a blistering agent even at very low concentrations. The spent aqueous layer from the above reaction should be handled with care. It may be saturated with HCl gas and used again, or decontaminated with gaseous chlorine before disposal. It may also be decontaminated by means of bleaching powder paste, as described below.

Mustard should be used in a hood with a good draft. One should avoid breathing the vapor and should allow neither the liquid nor the vapor to contact any part of the body. Particular care should be taken not to expose the eyes to mustard vapor by working for prolonged periods with the head inside a hood containing it.

Rubber gloves should be used in handling mustard. If the gloves become contaminated, immerse them for 4 hrs in boiling water before the next use. Gloves made of rubber which is about 35 mils thick may be worn with safety for about an hour after they have been contaminated with liquid mustard. As an added precaution, wash hands frequently when working with mustard, especially if it is suspected that the hands have become contaminated. Mustard must be washed from the skin immediately after contact to eliminate danger of burns.

Decontaminate glassware by immersion in concentrated nitric acid at room temperature in a hood. In a short time a reaction will take place with evolution of brown fumes. The mustard reaction products are toxic but have a very low vapor pressure. After treatment with nitric acid, the glassware should be washed thoroughly with water and the sink thoroughly flushed. Bulk mustard should be added to nitric acid with caution (preferably dropwise), because the reaction is violent.

Should mustard be spilled on a laboratory bench or on the floor, don gas mask and rubber gloves and decontaminate promptly as follows:

(a) Soak up all liquid with rags and dispose of the latter by incineration.

(b) Scrub the contaminated surfaces with a paste of bleaching powder and water. Allow the bleach paste to remain in contact with the surface for 24 hrs, then remove paste and wash the surface with soap and water. Dry bleach must not be mixed with bulk mustard, because the reaction is violent and *flammatory*.

Small objects which cannot be placed in nitric acid may be decontaminated by immersion in either a carbon tetrachloride solution of chlorine or Dichloramine-T or a slurry prepared by mixing equal weights of bleaching powder and water. Mustard readily penetrates porous materials such as paint films or wood. Only the surface contamination is removed by a quick treatment of such materials with decontamination agents. A relatively long contact with bleaching powder or solutions containing active chlorine is required to decontaminate porous surfaces effectively.

Incineration is a convenient method of disposal of small quantities of contaminated material such as clothing, rags, or wood. Since some undecomposed mustard vapors may be given off, the incinerator stack should be so located that the toxic fumes will not constitute a hazard.

[1] For purification by crystallization, see *J. Amer. chem. Soc.*, 1947, **69**, 1808.

The Excystment of *Colpoda duodenaria*

A. G. R. STRICKLAND and A. J. HAAGEN-SMIT

Kerckhoff Laboratories,
California Institute of Technology

The formation of cysts by certain protozoa can be studied as a problem of cellular differentiation. The genus *Colpoda*, and specifically the species *C. duodenaria*, forms permanent or resting cysts when the medium is deficient in available food, provided that the concentration of the protozoa is not too low. As far as can be ascertained, there are no structural parts to the resting cyst, other than cytoplasm and nuclei contained in one or more membranes. Redifferentiation can be followed by staining the cyst at intervals after immersion in an excystment medium, such as hay infusion, yeast extract, etc.

Excystment induced by some carbon compounds of low molecular weight (*1*) and excystment induced by potassium phosphate with or without such carbon compounds (*2*) have been reported, but in no case has the medium been as efficient (measured by the time required for 50% of the cysts to emerge) as, for instance, the optimum concentration of yeast extract; the optimum concentration

of the potassium phosphate was found to be around 0.01 M.

We can now report that ethyl alcohol in combination with potassium phosphate (pH 7) gives an excystment medium as potent as the optimal yeast extract, and that the concentration of potassium phosphate required in this case is 0.0001 molar, or 15 μg/ml. This quantity of the phosphate might well be present in complex excystment media, such as soil extract, urine, and organic infusions. Three-tenths M ethyl alcohol without phosphate kills most or all of the organisms as they emerge from the cyst membrane; 0.00001 M potassium phosphate completely protects them from injury.

In a medium composed of 0.3 M ethyl alcohol, and 0.0001 M potassium phosphate in distilled water, 50% of the organisms were fully differentiated and have emerged from the cyst membranes in 100 min at 24°C.

References

1. HAAGEN-SMIT, A. J., and THIMANN, K. V. *J. cell. comp. Physiol.*, 1938, **11**, 389.
2. STRICKLAND, A. G. R., and HAAGEN-SMIT, A. J. *J. cell. comp. Physiol.*, 1947, **30**, 381.

Book Reviews

General psychology. John E. Bentley. Philadelphia-London-Montreal: J. B. Lippincott, 1947. Pp. xvi + 389. (Illustrated.) $3.50.

This book is designed as a text for the beginning student in General Psychology, special consideration being given to the needs of the student nurse. The contents are presented in 5 major divisions: the organic basis of human psychology, sense activity and experience, learning, personality adjustment, and applications of psychology to nursing. This text places greater stress on sensory and perceptual processes than is found in many books now offered for the beginning student. The discussion of the nervous system and the senses together occupy one-fourth of the book; perception, memory, and reasoning also receive extensive treatment. While nearly all topics customarily found in textbooks of general psychology are considered here, some receive only the briefest mention, e.g. the conditioned response.

The diagrams are exceptionally fine and should prove of great value to students. A glossary and supplementary section, which provides a few lines of material about important people cited in the book, should also be of help. Much of the writing, however, is abstruse and so condensed as to require very close attention on the part of the beginner. General statements are offered without supporting evidence. Perhaps because the author was chiefly concerned with the student nurse, much attention is given to disorders and maladjustments, in addition to the normal functions and processes studied. Suggestions and advice are offered to the student on such matters as the improvement of memory, the relief of worry, etc. While such advice is designed to be helpful, it is presented so tersely that it fails to achieve its purpose.

Students should find the organization of this book rather easy to follow. Each of the 5 major sections and every chapter is introduced by an outline of its contents, designed to orient the student in his study. Each chapter has several major and numerous minor subdivisions, making this a textbook well designed for study purposes. Some sections, however, are broken up so fine as to contain little more than definitions. This text might well have been expanded to twice its size so that more concrete material could have been included. Some topics would benefit by more extended treatment and by inclusion of experimental supporting material.

MAX MEENES

Howard University

Radar aids to navigation. John S. Hall. (Ed.) (Massachusetts Institute of Technology Radiation Laboratory Series.) New York-London: McGraw-Hill, 1947. Pp. xiii + 389. (Illustrated.) $5.00.

Of the 28 publications planned in the Radiation Laboratory Series, this is No. 2; 33 authors have written parts of the volume. L. A. Turner was technical editor, R. A. Whitmer and R. G. Herb also helped with the editing, and many other persons had a share in assembling the material. The series bears the imprint of OSRD and NDRC, as well as of MIT, and evidently will involve as many contributors as an encyclopedia. This is understandable and necessary in a presentation of teamwork on the unprecedented scale of wartime radar development in the United States, Britain, and Dominions. There is a general Foreword by L. A. DuBridge, as well as the Preface by J. S. Hall, who regrets that "the authors have not always found it possible to present this information in nontechnical form." Description is facilitated by many photographs and diagrams. Throughout the book the editors have achieved a remarkable uniformity of style.

This highly authoritative book is invaluable for the navigational engineer, but necessarily is too inclusive and condensed to appeal to all ordinary navigators. There are four parts. Part I is a general introduction, discussing principles of radar and of other radio navigational methods, including radio ranges, Sonne, u-h-f aids, direction finders, and the various once-secret systems allied to loran, including Gee, "skywave-synchronized" loran, and Decca. Shoran is mentioned in a later chapter, under Radar Aids to Mapping. The short comment on celestial navigation lists its disadvantages but not the

matching disadvantages of radio navigation, which likewise can be blocked by bad "radio weather."

Part II deals in detail with Airborne Radar, Part III with Ground-Based Radar, and Part IV with Shipborne Radar. There is a 7-page index.

Perhaps the general reader will find most interest in the photographs of the PPI, which offer a type of map which is still novel to most people. In particular, from airborne radar, small-scale approximate maps of built-up areas of cities can readily be secured (e.g. Fig. 3–4, Hartford and others). These well may prove of advantage to demographers and regional planners. This reviewer may be pardoned for comparing the complexity of radar in World War II, which measured to microseconds times of arrival of radio waves, with the primitiveness of our old sound-ranging in World War I, which measured to hundredths of seconds the arrival of sound waves—and which was regarded then as one of the most intricate types of combat equipment. Developments based on it have proved invaluable in finding oil-rich geological structures underground. Apart from navigation, what new peacetime successes will radar have? Already radar plays a growing role as an astronomical instrument, and the microwave techniques are contributing importantly to spectroscopy.

JOHN Q. STEWART

Princeton University

Scientific Book Register

ALEXANDER, JEROME. *Life: its nature and origin.* New York: Reinhold, 1948. Pp. vii + 291. (Illustrated.) $5.00.

BACHMAN, C. H. *Techniques in experimental electronics.* New York: John Wiley; London: Chapman & Hall, 1948. Pp. vii + 252. (Illustrated.) $3.50.

BONIN, GERHARDT VON, and BAILEY, PERCIVAL. *The neocortex of Macaca mulatta.* (Illinois Monographs in the Medical Sciences, Vol. V, No. 4.) Urbana, Ill.: Univ. Illinois Press, 1947. Pp. xi + 163. (Illustrated.) $3.00.

BURK, R. E., and GRUMMITT, OLIVER. (Eds.) *Frontiers in chemistry.* Vol. V: *Chemical architecture.* New York-London: Interscience, 1948. Pp. 202. (Illustrated.) $4.50.

CLARK, AUSTIN HOBART. *A monograph of the existing crinoids.* Vol. I: *The comatulids.* Part 4b: *Superfamily Mariametrida (concluded—the family Colobometridae) and superfamily Tropiometrida (except the families Thalassometridae and Charitometridae).* (Smithsonian Institution-U. S. National Museum, Bull. 82.) Washington, D. C.: U. S. Government Printing Office, 1947. Pp. vii + 473. (Illustrated.) $2.75.

CLIFTON, C. E. (Ed.) *Annual review of microbiology.* (Vol. 1.) Stanford, Calif.: Annual Reviews, 1947. Pp. vii + 404. $6.00.

COSGROVE, C. G. *Caves of the Upper Gila and Hueco areas in New Mexico and Texas.* (Pap. Peabody Museum of American Archaeology and Ethnology, Harvard Univ., Vol. XXIV, No. 2.) Cambridge, Mass.: Peabody Museum, 1947. Pp. xv + 181. (Illustrated.) $6.25.

DUBS, ROBERT. *Angewandte Hydraulik.* Zürich, Switzerland: Rascher Verlag, 1947. Pp. 408. (Illustrated.)

EILERS, H., SAAL, R. N. J., and VAN DER WAARDEN, M. *Chemical and physical investigations on dairy products.* (Monographs on the Progress of Research in Holland.) New York-Amsterdam: Elsevier, 1947. Pp. xii + 215. (Illustrated.) $4.00.

GORTER, C. J. *Paramagnetic relaxation.* New York-London-Amsterdam-Brussels: Elsevier, 1947. Pp. vii + 127. (Illustrated.) $2.25.

GRABAR, PIERRE. *Les globulines du sérum sanguin.* Paris: Masson, 1947. Pp. 136. 200 fr.

HODGE, W. V. D., and PEDOE, D. *Methods of algebraic geometry.* Vol. I—Book I: *Algebraic preliminaries;* Book II: *Projective space.* Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1947. Pp. viii + 440. $6.50.

KRAFT, VICTOR. *Mathematik, Logik and Erfahrung.* Vienna, Austria: Springer-Verlag, 1947. Pp. 129.

NEVILLE, LESLIE E., and SILSBEE, NATHANIEL F. *Jet propulsion progress: the development of aircraft gas turbines.* New York-London: McGraw-Hill, 1948. Pp. xii + 232. (Illustrated.) $3.50.

PASQUINI, PASQUALE. *Le forze creatrici dell'uovo: questioni moderne d'embriologia.* Pisa-Roma, Italy: Vallerini, 1948. Pp. 330. (Illustrated.)

PAULIAN, RENOUD. *Observations ecologiques en forêt de Basse Côte d'Ivoire.* Paris: Paul Lechevalier, 1947. Pp. 147. (Illustrated.) 600 fr.

ROSSINI, FREDERICK D., *et al. Selected values of properties of hydrocarbons.* (Circ. National Bureau of Standards, C461; prepared as part of the work of the American Petroleum Institute Research Project 44.) Washington, D. C.: U. S. Government Printing Office, 1947. Pp. xiii + 483. $2.75.

SHRINER, R. L. (Ed.-in-Chief.) *Organic syntheses.* (Vol. 27.) New York: John Wiley; London: Chapman & Hall, 1947. Pp. vi + 121. $2.25.

STREHLOW, T. G. H. *Aranda traditions.* Victoria: Melbourne Univ. Press, 1947. Pp. xxii + 181. (Illustrated.) 17s. 6d.

TORREY, HENRY C., and WHITMER, CHARLES A. *Crystal rectifiers.* (Massachusetts Institute of Technology Radiation Laboratory Series.) (Ed. by S. A. Goudsmit, *et al.*) New York-London: McGraw-Hill, 1948. Pp. xiii + 443. (Illustrated.) $6.00.

WALLIS, W. F., and GREEN, J. W. *Land and ocean magnetic observations, 1927–1944.* (Researches of the Dept. Terrestrial Magnetism, Vol. VIII.) Washington, D. C.: Carnegie Institution of Washington, 1947. Pp. 243. (Illustrated.) $1.25, paper; $1.75, cloth.

———. *Classified directory.* (11th ed.) New York: Association of Consulting Chemists and Chemical Engineers, Inc., 1947. Pp. 120. Gratis.